ENGINEERING NEWS

PLANS FOR A CHANNEL BRIDGE are said to have been completed by Messrs. SCHNEIDER & HERSENT. It would extend from Cape Grisnez to Folkestone, a distance of 22.8 miles. It is to be about 100 ft. wide, with 4 lines of rails and a carriage-way. The estimate for foundations and masonry is $72,000,000, and the total cost is put at $180,000,000. On this a traffic is figured of 20,000,000 tons of freight and 2,250,000 passengers annually, with "a net profit of $26,000,000." There is nothing particularly modest about the scheme, anyhow.

THE FORTH BRIDGE was erected at the rate of 2,000 tons of material for each of the months of August, September and October last. It is said that only 9,000 tons are required to be yet put in place; and it is hoped that the bridge proper will be finished next May. Oct. 30, 1889, is the date fixed for the entire completion of the work.

THE BUFFALO GRADE-CROSSING QUESTION seems to be at last in a fair way to be definitely settled. The commission chosen to confer with the different rail. way managers interested in the proposed changes of grade have succeeded in obtaining from Mr. CHAUNCEY M. DEPEW, of the New-York Central Company, his consent to an agreement, which, although not all that the city claimed, is still regarded as fair and reasonable. The Commissioners' original proposition was that the city should pay 25 per cent. of the cost of the approaches, and that the railways should bear *pro rata* share of the balance. This the companies refused to consider, and declared that the cost should be borne in equal shares. The matter, so far as the Central is concerned, has been modified, and if the project is carried out, the city will bear one-third of the expense and the companies the other two-thirds.

SIXTY-ONE GRADE CROSSINGS have been changed in Connecticut at a cost of $443,628, or an average of $7,272 for each crossing. As the most dangerous crossings were first changed, and these were mainly in the cities, this is not an extravagant figure, and the country crossings should not cost more than half of this. Of the total expended, the railway companies paid $394,433 and the towns the remaining $49,195. Averaging the town and county crossings at $3,000 each, the 1,200 crossings in that State would cost about $3,600,000 to change; a small outlay when compared with the saving in human life and the increased convenience to the railroads and the public.

THE NICARAGUA CANAL CO. has completed its plans and estimates in great detail and has appointed Messrs. JOHN BOGART, E. D. T. MYERS, C. T. HARVEY, H. A. HITCHCOCK and A. M. WELLINGTON a Board of Engineers to examine and report upon the plans and estimates for the work, which have been completed in much detail. The longitudinal profiles are to the usual railway scale of 400 ft. horizontal and 30 ft. vertical per inch, with frequent borings showing the nature of the material. The work appears to have been most admirably and faithfully done, giving every detail necessary to form an exact estimate of quantities.

A DRAINAGE CANAL, 14 miles long, 20 to 30 ft. wide and 7 to 12 ft. deep, is to be cut through Tuscola, Arcola and Bowdre townships in Douglas County, Illinois. It is to cost from $200,000 to $250,000. But the farmers are fighting the project on the ground that they have not asked for it and object to the assessments to pay for it.

TOLLS ON RIVER AND CANAL TRANSPORTATION were abolished in France in 1880. The railway companies point out that the ton mileage on French railways has decreased 700,000,000 since 1880, and the traffic by the waterways has increased 800,000,000 tons since the same date. They now want the Government to restore the canal tolls. It has never occurred to them, apparently, that there might be profit in reducing the railway rates, as was done on the N. Y. Central R. R. when Erie Canal tolls were abolished.

THE NAVAL APPROPRIATION BILL, passed by the Naval Committee, makes the total sum available for League Island improvements $726,000; and also provides for another cruiser of the *Vesuvius* type, and recommends the construction of the Thomas submerging war-ship.

LARGE TESTING MACHINES are recommended for New York and Mare Island navy yards by Engineer-in-Chief G. W. MELVILLE. He also suggest the economy of central steam and electric generating plant at navy yards, instead of the present divided system.

TWO MONSTER RUSSIAN GUNS were sent recently to Sebastopol to be placed in the new iron-clad *Sinope*. They are 12-in. pieces, weighing 50 tons, and throwing projectiles of nearly half a ton. The powder charge is 270 lbs., and the initial velocity 3,000 metres, while the distance of the cannon's range is said to be "over 13 miles." As a consequence, the fire of the guns can only be directed by a map. Firing from sea level, an ordinary vessel at the extreme range would be out of sight. Two men suffice for each gun, which is worked by hydraulic machinery. So says an English press account.

HOWELL TORPEDOES, to the number of 30, at $2,200, and 10 sets of launching apparatus at $3,800 each, were contracted for last week by the Navy Department with the Hotchkiss Ordnance Co. The option remains with Secretary WHITNEY to increase this order to 50 torpedoes, at $1,936 each, and 15 launching machines at $3,200 each, at any time prior to the delivery of the weapons. These are the first Howell torpedoes ordered by the Government, and are intended for the new steel cruisers. It is an automobile torpedo guaranteed to make a speed of 22½ knots in 400 yards, and not to deviate more than 15 yards to the right or left of the object aimed at, or 2 ft. above or below the depth started at.

THE MERCHANTS' BRIDGE, over the Mississippi river at St. Louis, will have 3 spans of 518 ft. each *c.* to *c.* of end-pins, with an approach at either end 425 ft. long; each approach will probably be in 3 spans founded on cylinder piers. The clearance under the bridge will be 50 ft. at high-water. The contract for the entire work excepting the rails is let to the Union Bridge Co., of New York, for a total sum of about $1,000,000, and the firm of Anderson & Barr is associated with the Union Bridge Co. for the execution of the foundation work. The contract calls for the completion of the bridge by June 30, 1890. The distance from high-water to bed-rock at each of the main piers is as follows:—Pier I (east), 79 ft.; Pier II, 72.5 ft.; Pier III, 72 ft. and Pier IV, 71.5 ft. The difference between high and low water is 33.37 ft. As previous reports, taken from the daily press, have been somewhat mixed, the above data may be taken as correct as it is given us by the best possible authority.

BRIDGE ACCIDENTS are reported as follows:—On Jan. 16, a wooden bridge on the Northwest & Florida road, near Patsburg Station, Ala., gave way under the engine of an accomodation train. The engine and several cars were wrecked. No lives were lost. ——On Jan. 20, the draw of the Louisville, St. Louis & Texas bridge across Green river at Spottsville, Ky., fell into the river; one man was killed and 6 injured, 3 fatally. The press dispatches give the following account: The railway company was granted an injunction on Jan. 16, by the Circuit Court of Henderson County against the Keystone Bridge Co., prohibiting the latter from interfering with the plaintiff's trains running over the bridge, and the order was served by the Sheriff on the bridge company. The order, it seems, was obeyed until the date of the accident, when the bridge company sent a force of men to the bridge, who drove the railway employés off, and at once began the work of tearing up the track and a portion of the ties from the draw of the bridge. In the afternoon, while the work of tearing up the ties was in progress, the dismantling of one end of the draw caused the opposite end to overbalance, when it broke, precipitating about 20 of the workmen into the river.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was the derailment of the rear car of a Chicago & Northwestern train near Elmwood, Mich., on the Menominee River branch, on Jan. 19. The accident is said to have been caused by a broken truck or car wheel; the car left the track, and fell over on its side, and was wrecked by striking some stumps, one of which penetrated the side of the car, killing one man. Three persons were killed, including Lieut. Gov. MACDONALD, of Michigan, and six others were seriously injured.

A LOCOMOTIVE BOILER EXPLOSION occurred Jan. 21, while a new locomotive built at the Pennsylvania Railroad shops at Blairsville, Pa., was being tested. One man was killed and 2 were injured.

EARTHQUAKE SHOCKS continue to be reported. Shocks were felt at Gilroy, Cal., on Jan. 10, and at Edinburg, Scotland, on Jan. 18.——Late advices from Costa Rica, regarding the earthquake of Dec. 30 last, briefly mentioned in our issue of Jan 12, say the shocks were the most severe experienced since 1862. In San José both the national Capitol and the magnificent cathedral, the President's palace, city hall, national post office and several other public buildings were almost totally wrecked. Advices from surrounding cities report the shock even more severe, and bring accounts of loss of life and property.

THE latest estimate of the damage throughout the country exceeds $5,000,000. The volcano has suddenly become active. It is located 28 miles northwest of San José, at an altitude of 8,895 ft. above the sea. It had been sleeping for years, and only a couple of weeks before the earthquake a party of explorers, after a visit there, reported the crater entirely filled up. Now it has broken out with all its old fury, and in another place half a mile distant from the original mouth. An average of three slight shocks was felt daily for several days after the first.

THE BROOKLYN BRIDGE has had two slight interruptions of traffic. The jumping of a switch by a car truck at the New York end, Jan. 22, caused the carrying away of the iron railing along the landing platform and the smashing of a part of the picket fence which connects with it. The train of four cars had discharged its passengers and the switching engine started to pull it to the opposite track, when the forward truck of the last car jumped a frog and ran along a side track, the rear truck continuing after the other cars. Another train lost its grip on the cable about half way over and had to return back to the station to take it again, causing delay but no other trouble.

THE FORTH BRIDGE has been reported upon by Gen. HUTCHINSON, for the 23rd quarter, under date of Nov. 30, 1888. The condition at that time was as follows: *South Queensferry*, south cantilever: extreme distance out from vertical columns 435 ft., of which distance 295 ft. are riveted; the top members extend 415 ft. from the vertical columns. The north cantilever is built out 460 ft. at the bottom; the viaduct was 161.5 ft. above datum. *Inch Garvie*, south cantilever; the bottom members are built out 408 ft. and the top 390 ft. On the north cantilever the bottom members extend out 340 ft. *North Queensferry*, south cantilever; the bottom members are built out 450 ft. and the top 425 ft. On the north cantilever the bottom members extend out 435 ft. and the top 390 ft. At the date given 610,000 cu. ft. of granite had been set and 113,250 cu. yds. of rubble masonry and concrete built. In all 56,680 tons of steel have been delivered, or an addition of 1,150 tons in the quarter. On Nov. 16, a gale of exceptional violence visited the bridge and the wind pressures recorded were 41 lbs. on the small gauge at Garvie Castle and 27 lbs. on the large gauge at same place. The number of men employed on Nov. 30 was 2,970, with an average of 3,300 for each day in the quarter.

THE ELEVATED TRAINS in New York and Brooklyn had several accidents on the morning of Jan. 24, due to the heavy fog which suddenly settled down over the cities. The accidents were all rear collisions and were due to the close headway under which trains are run in the rush hours, and the fact that in the dense fog the engineers could hardly see a car length ahead of their engines. On the Kings County Elevated in Brooklyn, a train just leaving the Nostrand Avenue station was run into by a following train. The collision was slight, but during the panic which ensued among the passengers, one man jumped into the street and was killed by the fall. On the New York Elevated at 104th St. a rear collision occurred severe enough to break up the cars somewhat, and severely bruise a number of passengers. The panic caused by the first collision was increased by a third train running into the rear of the second, but this collision was a light one and did little damage. In case of fog it is customary

to station signal men along the track who keep trains the proper distance apart; but in this case the fog shut down and the accident occurred before the signal men had time to reach their posts.

THE "ATLAS" WRECK, in the North river off Barclay St., should be blown up, instead of waiting the convenience of owners or a wrecking company. In the fog of Thursday one of its masts was broken off in a collision with a tug and the stumps are a more dangerous obstruction than ever in this most crowded part of a river filled with shipping. This derelict lies in the track of ferryboats carrying 40,000 or 50,000 people daily, and the U. S. Government should take steps to remove it in the most expeditious manner possible, regardless of individual profit or loss in the undertaking.

A FLASH SIGNAL LIGHT for the rear of trains has recently been tested on the New York Ontario & Western road. When the train is stationary it shows a fixed light; when in motion alternate flashes of white and red, so displayed as to indicate whether the train is going forward or backward. The motion of the train revolves the lights, and to an experienced eye the frequency of the flashes indicates the rate of speed at which the train is moving.

THE PENNSYLVANIA RAILROAD CO. is stated to be so well pleased with the Sprague electric transfer table, at the Altoona shops, that it has ordered another one put in at Reading, Pa.

A PORTLAND company has received orders to build another bicycle locomotive, which will cost about $8,000, for E. MOODY BOYNTON. The company will also build a track of about 300 yds. in length in their yard, on which to make a trial of locomotive and car when completed, about a month hence.

AN IMPORTANT AFRICAN RAILWAY is projected by a company just formed in Brussels. It is to be 250 miles long, to connect the head of navigation on the lower Congo with Stanley Pool and the 6,000 miles of navigable waterways above it. The expectation is that it will stimulate traffic between the Upper Congo and the markets of Europe.

THE SUTRO TUNNEL was sold, under a decree of foreclosure, on Jan. 14, to HENRY C. DIBBLE for the Sutro Tunnel Co., of New York, which now holds the mortgage of McCalmount Bros., London. The price paid was $1,325,000. It will probably be reconveyed to the Sutro Tunnel Co.

THE MATTOCK'S PIPE-MAKING PLANT was set in operation last week at the Wheatland rolling mill in Sharon, Pa. The press accounts give no details. The purpose of the machine is said to be the manufacture of rolled iron-pipe, and is described as requiring only two men to operate it, saving in labor in the proportion of 16 to 1.

THE ELEVENTH CENSUS BILL, now before the House, provides for a greater mass than ever of comparatively useless information on all manner of subjects of minor interest. The cost will be increased, and the valuable results delayed by this favoring of parties with statistical hobbies. The census once in 10 years is at too long an interval anyhow for this rapidly moving age. We should have the population and a few other of the essential statistics taken every five years to be of real value. And the aim should be to simplify this undertaking rather than to load it with useless data that delay the issue of the useful.

THE "KEY WEST PILE ARMOR", specified by Chief Engineer MARSDEN MANSON for covering 1,387 piles to be used in the new Fremont St. wharf, San Francisco, is described as follows:—The piles are to be barked, and then coated with hot asphaltum mastic, after which a covering of No. 10 nine-ounce canvas must be attached with tacks not more than 4 ins. apart, after which another coating of mastic is to be applied.

THE EIFFEL TOWER is now 700 ft. high. It is now the highest structure in the world.

BOSTON COPPER STOCKS are becoming a very soft, kind of property. A review ending Dec. 31 gives interesting comparison of 1888 with 1887, showing the effectiveness of the international "combine" known as *La Société Industrielle Commercial Des Métaux*

	1888	1887.
Calumet and Hecla	$2,000,000	$1,000,000
Tamarack	640,000	....
Boston and Montana	400,000	....
Quincy	300,000	200,000
Franklin	200,000	80,000
Osceola	150,000	100,000
Atlantic	120,000	40,000
Central	70,000	40,000
Total	$3,940,000	$1,460,000

This shows an increase in dividends for the year of $2,840,000 paid on copper stock investments from the operations of the French syndicate.

On Dec. 30, 1887, the total market value of the eight copper stocks enumerated above was $33,065,000. The present market value of these stocks is $49,327,500, an increase of $16,262,500, or about 50 per cent., while at the same time the aggregate amount of dividends disbursed has increased 170 per cent. There are a dozen or more of non-dividend paying but producing copper stocks besides; and adding their present market value to that of the eight bonanza companies gives a total market value for Boston's copper stocks of $62,000,000, or a total increase for the year of $25,000,000, practically all due to the new "combine." "It is a cold day when Boston gets left."

PANAMA CANAL SECURITIES follow the illustrious precedent of the great Alabama cotton loan in declining to fall very rapidly to zero. On Dec. 31 the Bourse quotation for shares (par $100, all paid) was $25. The quotations for bonds were: Five per cent. of 1882, ($100), $26.40; 3 per cent. of 1883, ($100), $18.20; 4 per cent. of 1884, ($100), $19.60; 6 per cent. ($200), $30; the lottery bonds, ($80), $45.60. The last named are protected in some measure by the fund deposited with the Crédit Foncier, as required by the law. The quotations may be in part fictitious, to aid the gang in unloading.

THE GRAND TRUNK FERRY across the St. Clair river between Port Huron, Mich., and Sarnia, Ont., transferred during 1888 the following cars: Freight cars, all kinds 296,208; passenger cars, 27,667; baggage and mail cars, 7,920.

A computation of the number of miles which these cars would reach if made up in a continuous train, estimating the average length of a freight car at 30 ft., a baggage car at 40 ft., and a passenger car, 50 ft., shows that the freight cars would reach 1,683 miles, the passenger cars 262 miles, and the baggage cars 60 miles. Evidently the St. Clair tunnel will have a pretty heavy traffic when it is completed.

A PONTOON BRIDGE is proposed across the Mississippi river at Winona, Minn. The boats would be 12 × 24 ft., with a draw in the shape of a a V lying in the river at an angle of 45° to the causeway; this draw to be opened and closed by the the action of the current on rudders. The length of the bridge would be 1200 ft. and the cost is estimated at $24,000 Col. S. N. STEWART is the designer of the bridge.

THE WEATHER continues remarkably mild and unseasonable all over the United States, a fact which may or may not have some connection with the excessive rainfall of last year, which has averaged something like 10 ins. over the average of the past 20 or 30 years. Even in Maine the ice in the rivers has all gone out, and there is little snow on the ground. As yet there is no sign of a severe winter.

THE CLEVELAND WATER-WORKS TUNNEL is making satisfactory progress, but as near as we can learn 7,000 ft. yet remain to be excavated out of the total 9,200 ft. This tunnel is 7 ft. in diameter.

SOME OF THE EXTREMES to which railway competition has run in the West is evidenced by a report from Minneapolis that the Chicago, Milwaukee & St. Paul is to dismiss its "street men" on Feb. 1. It seems that it has become customary in that enterprising city for the railway companies to employ agents to button-hole passers-by in the street and solicit business for their respective lines. The *Pioneer Press* says these men often make themselves a nuisance and annoyance, which seems very probable. If the first fruit of the recent Presidents' agreement is the abolition of this manifest abuse, one step has certainly been taken in the right direction.

Duty Trials of Pumping Engines.*

(*Concluded from page 47*).

CONDUCTING DUTY TRIALS.

1. It is presumed at the outset that the engine is in thorough order in every part, having been in operation a sufficient length of time since its erection to secure easy and proper working. If this has not been done, and especially if the plunger has been recently packed, or its packing newly readjusted, the engine is worked for a run of at least 12 hours continuous service in preparation for the test.

2. The plant is subjected to a preliminary run under the conditions determined upon for the test, for a period of at least 3 hours, so as to find the temperature of the feed water, or the several temperatures, if there is more than one supply, for use in the calculation of the dufy. During the run the observations are made every fifteen minutes, and the results arranged.

If the feed water is all obtained from one source and there is no heater, the temperature to be found is that of the water supplied to the feeding instrument, whether this instrument be a pump or an injector. If a heater is used, which depends upon heat derived from that rejected either by the engine or by some accessory part of the engine, the temperature to be found is that of the water leaving the heater; but in case the feeding apparatus is an injector, the temperature found at this point is to be reduced by the number of degrees which this instrument adds to the water.

If there are two independent sources of supply, one the main supply from the hot well or from some other source, and the other an auxiliary supply derived from the condensed water of the jackets or live steam reheater, as often occurs, they are to be treated independently. The remarks already made apply to the first or main supply. The auxiliary supply is generally carried direct to the boiler or to the main feed pipe near the boiler, by an independent pipe, and its temperature is to be taken at any convenient point in that pipe.

If a separator is used in the main steam pipe discharging into the boiler by gravity, no account need be taken of the water thus returned. Should it discharge either into the atmosphere to waste, or into the hot well, or into the jacket tank, its temperature is determined at the point where the water leaves the collecting chamber of the separator before its pressure is reduced.

Where a separator is used, and it drains by gravity into the jacket tank, this tank being subjected to boiler pressure, the temperature of the separator water and jacket water are taken independently before their entrance to the tank.

Should there be any other independent supply of water, the temperature of that is also taken on this preliminary test.

3. The engine is now stopped for a time in order first to connect up the measuring apparatus for determining the weight of the feed water consumed; and second, to test the leakage of the plungers.

In order that the main supply of feed water may be measured, it will generally be found desirable to draw it from the cold water service main. When this is done, the best form of apparatus for weighing the water consists of two tanks, one of which rests upon a platform scale supported by staging, while the other is placed underneath. The water is drawn from the service main into the upper tank, where it is weighed, and then it is emptied into the lower tank. The lower tank serves as a reservoir, and to this the suction pipe of the feeding apparatus is connected.

The jacket water may be measured by using a pair of small barrels, one being filled while the other is being weighed and emptied. This water, after being measured, may be thrown away. To ensure no loss of evaporation on account of its highly heated condition, each barrel should be partially filled with cold water previous to using it for collecting the jacket water, and the weight thus added allowed for. When the jacket water drains back by gravity to the boiler, waste of live steam should be prevented by providing a small vertical chamber, and first drawing the water into this receptacle. A glass water gauge is attached so as to show the height of water inside the chamber, and this serves

*The name of the author of this paper was incorrectly given in last issue as Mr. GEORGE H. BARNES; it should read GEORGE H. BARRUS.

as a guide in regulating the discharge valve. The chamber may be made of piping; where the jacket water is returned to the boiler by means of a pump, it is desirable to throttle the discharge valve during the test, so that the pump may work against, as nearly as may be, its usual pressure, that is, the boiler pressure, a gauge being attached to the discharge pipe for this purpose.

The remarks as to the manner of measuring the jacket water apply also to the measurement of any other highly heated water which may be supplied to the boiler independently.

When the jackets are drained by a trap, and the water goes either to waste or to the hot well, the determination of the quantity used is not necessary to the main object of the duty trial. For the reasons which are noted in paragraph 4, however, it is desirable that this water be measured, whatever the use to which it is applied.

When a separator is used and it discharges either to waste or to the hot well, or to the jacket tank, the quantity discharged is determined, the same precautions being observed as in the measuring of jacket water. The entrained water thus formed is treated in the calculations in the same manner as the moisture shown by the calorimeter.

Should live steam be used for reheating the steam in the intermediate receiver, as occurs in some compound engines, it is desirable to separate this from the jacket steam and measure it separately. This is not essential, however, to the main object of the duty trial, though useful for purposes of information.

The quantity of water which leaks by the plungers is most satisfactorily determined by removing the cylinder head. A wide board or plank is temporarily bolted to the lower part of the end of the cylinder, so as to hold back the water, in the manner of a dam, and an opening is made in the temporary head thus provided, for the reception of an overflow pipe. The plunger is blocked at some intermediate point in the stroke (or if this position is not practicable, at the end of the stroke), and the water from the force main is admitted at full pressure behind it. The leakage escapes through the overflow pipe and it is collected in barrels and measured. The test need not continue over 15 minutes, or if carefully made, a less time, the desired object being to get a satisfactory determination of simply the rate of leakage. If no means exists for putting the back side of the plunger under water pressure, a suitable pipe can readily be provided for this purpose. Should the escape of water into the engine room be objectionable, a spout may be constructed to carry it out of the building. When the leakage is too great to be readily measured in barrels, or where other objections arise, resort may be had to weir or orifice measurement, the weir or orifice taking the place of the overflow pipe in the temporary wooden head The apparatus may be constructed in a somewhat rude manner and be sufficiently accurate for practical requirements.

In a case like that of the Worthington high duty engine, where it is difficult to remove the cylinder head, it may be desirable to take the leakage from one of the openings which are provided for the inspection of the suction valves, the head being allowed to remain in place. If the test is made without removing the head, leakage of the discharge valves may be confounded with leakage of the plunger. Examinations for such leakage should be made first of all, and if it occurs, and it is found to be due to disordered valves, it should be remedied before making the plunger test.

The leakage test being completed, no change is allowed in the adjustment of the packing of the plunger, the head is immediately replaced and preparations made for at once beginning the main duty trial.

4. The duty trial is here assumed to apply to a complete plant, embracing a test of the performance of the boiler as well as that of the engine. The test of the two will go on simultaneously after both are started, although the boiler test will begin a short time previous to the commencement of the engine test and end after the engine test is finished. The mode of procedure is as follows:

While the preparations are being made to start the engine, after the completion of the leakage trial, steam is raised in the boilers to the working pressure. The fire is then hauled, the furnace and ashpit cleaned, and the test of the boiler is commenced. This test is made in accordance with the rules for a standard method recommended by the committee on Boiler Tests of the American Society of Mechanical Engineers. This method, briefly described, consists in starting the test with a new fire, lighted with wood, the boilers being previously heated to its normal working degree; operating the boiler in accordance with the conditions determined upon; weighing coal, ashes and feed water; observing the draught, temperatures of feed-water and escaping gases and such other data as may be incidentally desired; determining the quantity of moisture in the coal in the steam, and at the close of the tests hauling the fire and deducting from the weight of coal fired whatever unburned coal is contained in the refuse withdrawn from the furnace, the quantity of water in the boiler and the steam pressure being the same as at the time of lighting the fire at the beginning of the test. Previous to the close of the test the fire is burned down to a low point so that the unburned coal withdrawn is in nearly a consumed state. The temperature of the feed-water is observed at the point where the water leaves the engine heater, if this be used, or at the point where it enters the flue heater if this apparatus is employed. In either case where an injector is used for supplying the water, a deduction is to be made for the increased temperature of the water due to this method of feeding.

As soon after the beginning of the boiler test as practicable, the engine is started and preparations are made for the beginning of the engine test. The formal commencement of this test is delayed till the plant is in normal working condition, which should be not over one hour after the time of lighting the fire. When the time for commencement arrives, the feed water is momentarily shut off, and the water in the lower tank is brought to a mark. Observations are then made of the number of tanks of water thus far supplied, the height of water in the glass gauge and the indication of the counter on the engine, after which the supply of feed-water is started and the regular observations of the test commenced. The test is to continue at least 10 hours. At its expiration the feed-pump is again momentarily stopped, care having been taken to have the water slightly higher than at the start, and the water in the lower tank is brought to the mark. When the water in the gauge glass has settled to the point which it occupied at the beginning, the time of day and the indication of the counter are observed, together with the number of tanks of water thus far supplied, and the engine test is held to be finished. The engine continues after this time to run till the fire reaches a condition for hauling and completing the boiler test. It is then stopped and the final observations relating to the boiler test are taken.

The observations to be made and data obtained for the purposes of the engine tests embrace the weight of feed-water supplied by the main feeding apparatus, that of the water drained from the jackets, and any other water which is ordinarily supplied to the boiler, determined in the manner pointed out. They also embrace the number of hours duration and the number of strokes of the pump during the test, as noted, together with the length of the strokes (in direct acting engines), the indication of the gauge attached to the force main, as also of the gauge attached to the suction main, and indicator diagrams from the pump. It is desirable that indicator diagrams be obtained also from the steam cylinders.

Observations of the length of stroke should be made every 5 minutes; observations of the water pressure gauges every 15 minutes; observations of the remaining instruments, such as steam gauge vacuum gauge, thermometer in pump well, thermometer in feed-pipe, thermometers showing temperature of engine room, boiler room and outside air, thermometer in flue, thermometer in steam pipe, if the boiler has steam heating surface, barometer and other instruments which may be used, every half hour; indicator diagrams should be taken every half hour, both from the steam and the water cylinders; should the diagrams from the pump be rectangular, they may be taken, if desired, with less frequency.

When the duty trial embraces simply a test of the engine apart from the boiler, the course of procedure will be the same as that described, excepting that the fires will not be hauled and the special observations relating to the performance of the boiler will not be taken.

5. In making preparations for the test, attention should be given to the following provisions in the arrangement of the apparatus:

The gauge attached to the force main is liable to a considerable amount of fluctuation unless the gauge cock is nearly closed. The practice of choking the cock is objectionable. The difficulty may be satisfactorily overcome and a nearly steady indication secured with cock wide open, if a small reservoir having an air chamber is interposed between the gauge and the force main. By means of a gauge glass on the side of the chamber and an air valve, the average water level may be adjusted to the height of the center of the gauge, and correction for this element of variation avoided.

To determine the length of stroke in the case of direct acting engines, a scale should be securely fastened to the frame which connects the steam and water cylinders, in a position parallel to the piston rod, and a pointer attached to the rod so as to move back and forth over the graduations on the scale. The marks on the scale which the pointer reaches at the two ends of the stroke are thus readily observed and the distance moved over are computed.

The form of calorimeter to be used for testing the quality of the steam is left to the decision of the person who conducts the trial. It is preferred that some form of continuous calorimeter be used which acts directly on the moisture tested. If either the superheating calorimeter or the wire drawing instrument be employed, the steam which it discharges is to be measured either by numerous short trials, made by condensing it in a barrel of water previously weighed, thereby obtaining the rate by which it is discharged, or by passing it through a surface condenser of some simple construction and measuring the whole quantity consumed.

If the steam is superheated, or if the boiler is provided with steam heating surface, the temperature of the steam is to be taken by means of a high grade thermometer resting in a cup holding oil or mercury, which is screwed into the steam pipe so as to be surrounded by the current of steam. The temperature of the feed water is preferably taken by means of a cup screwed into the feed pipe in the same manner.

To avoid errors in conducting the test due to leakage of stop valves, either on the steam pipes, feed water pipes or blow off pipes, all those pipes, not concerned in the operation of the plant under test, should be disconnected.

6. The engine is to be worked on the duty trial, unless otherwise stipulated, at its rated capacity of discharge.

7. In review of the method thus pointed out, the various steps may be summed up briefly as follows:

a. Preliminary run to determine the temperature of the feed water.

b. Erection of weighing apparatus, examination of pump, and test of plunger leakage.

c. Commencement of boiler test.

d. Commencement of engine test.

e. Boiler and engine test to go on simultaneously.

f. Close of engine test.

g. Close of boiler test.

THE PHILADELPHIA & READING RAILROAD has had built by the Baldwin works, for service upon its mountain division, some consolidation locomotives which are to be among the heaviest engines ever built. Their actual weight in working order is 153,040 lbs., 138,340 lbs. on drivers. They have a tractive force of 271 lbs. per lb. average pressure in the cylinder. The cylinders are 22 by 28 ins. stroke; driving wheels 50 ins. diameter; boiler 6 ft. in diameter and 13 ft. 6 ins. long over tube sheets. The tubes are 270 in number, 2¼ ins. in diameter. The fire box is over 11 ft. long inside by 42 ins. wide and is placed above the frames, but not above the wheels. The heating surface in the fire box is 185 sq. ft., and the total heating surface 2645 sq. ft. The engine is designed to burn anthracite, but not, like the Wootten engines, buckwheat or refuse coal. It will have the American steam brake on driving wheels and tender, and the Le Chatelier water brake.

Compound Locomotives, London & North Western Railway.

It is a singular fact that the compound locomotive, the most decided departure from the locomotive of GEO. STEPHENSON's day which has ever been attempted, remains almost exclusively a foreign experiment. Americans, who are generally foremost in adopting tentatively new devices, have let the compound locomotive severely alone. We have attempted elsewhere to suggest some causes for this neglect, and we may say at once that we have little hopes that the compound locomotive will become an established feature of railway practice for any kind of service. Nevertheless, it is dangerous to make positive predictions in this age of progress, and we make none such; and the experiments which are making abroad by various English and Continental engineers, must be watched by Americans with great interest. Among these designers and experimenters the most prominent by far is Mr. F. W. WEBB, Locomotive Superintendent of the London & North Western Railway, who has been building compound locomotives at intervals since 1878, and whose latest effort (in type) is admirably illustrated by *The Engineer*, from which we reproduce the accompanying engravings. Of the larger side view *The Engineer* says:

"Our engraving is as nearly as possible on a scale of 1in. to the foot. The engraving is consequently the largest that has ever been published of a locomotive engine. Of its merits our readers must judge. It has been prepared from a photograph of precisely the same size, courteously placed at our disposal by Mr. WEBB."

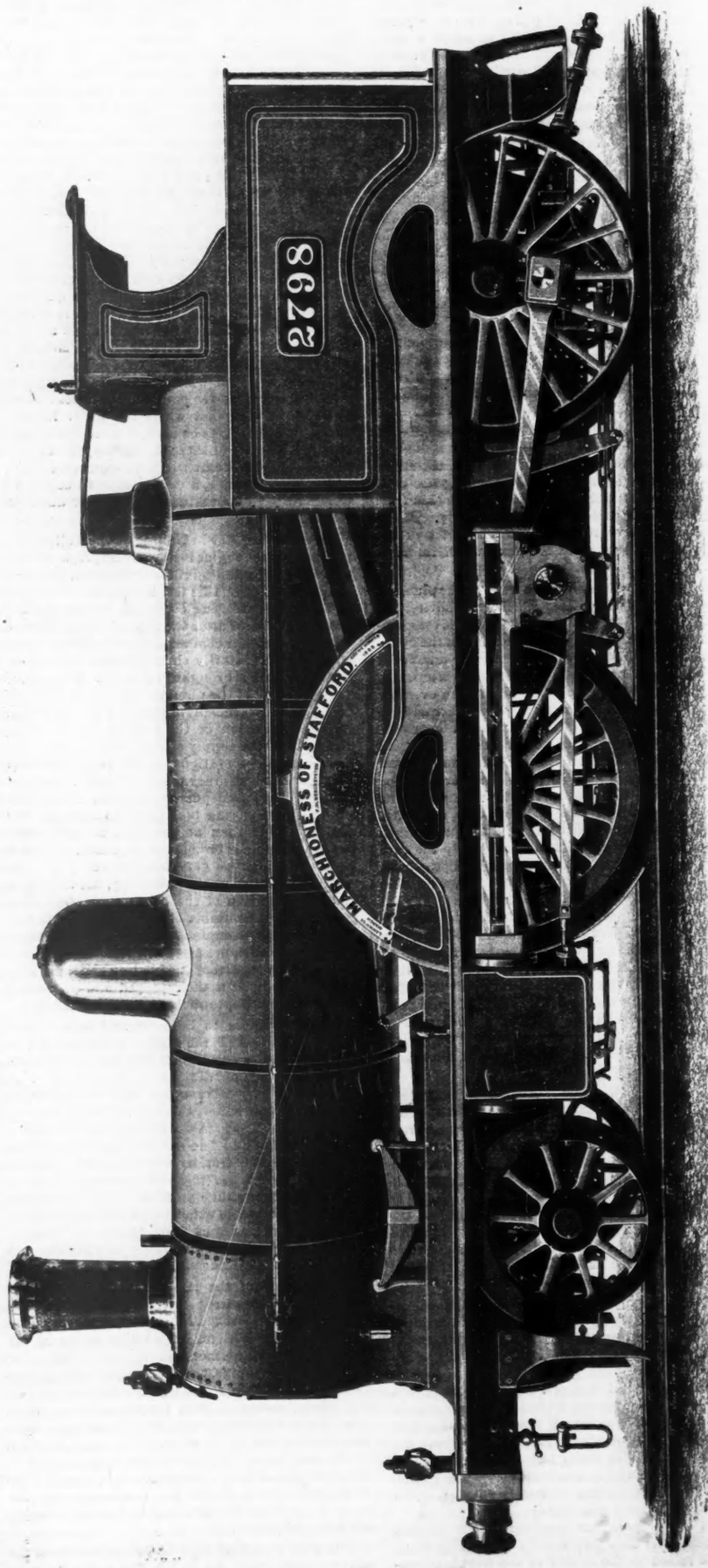
The Engineer also gives a history of Mr. WEBB's experiments (if they may still be called experiments with 74 engines at work) from which with some additions we abstract as follows:

For his first compound locomotive Mr. WEBB took an old inside 15 in. cylinder engine, and converted it on MALLET's system by lining up one cylinder to 9 in. diameter. The Mallet engine differed from the usual type only in having two cylinders of different sizes, one on each side, which could be worked either compound or "straight" high-pressure. Mr. WEBB's engines are a much more radical departure.

That engine worked light trains on a branch for about five years. The results were so satisfactory that Mr. WEBB next designed the *Experiment*, which was constructed at Crewe in the latter part of 1881, and during the first twelve months of its life ran 100,000 miles, principally with the Scotch and Irish mail trains. Its daily work was 319 miles. Mr. WEBB then proceeded to further developments, and he very fully described the engine he was building in 1883, in a paper read before the Institution of Mechanical Engineers at the Liége meeting, which took place in July of that year.

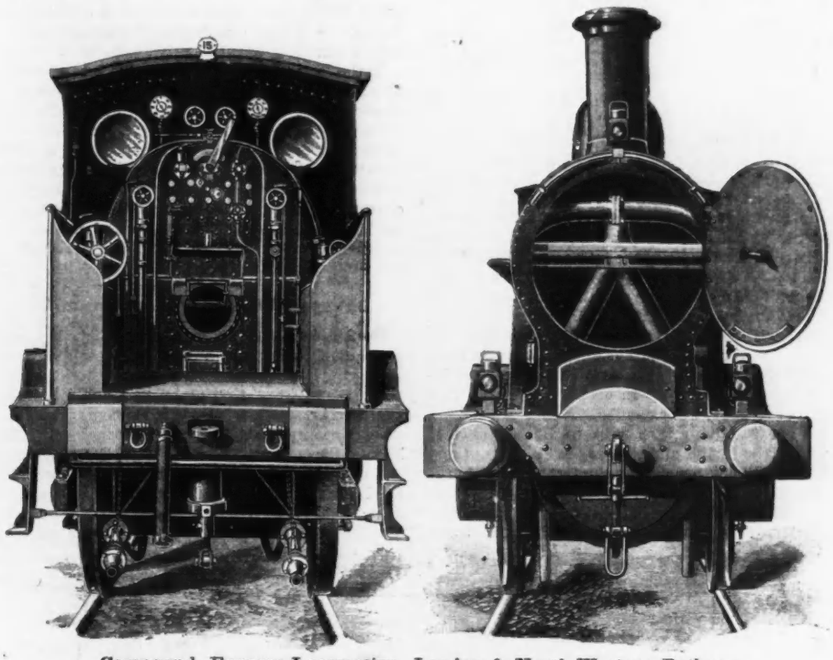
Subsequently he introduced modifications in the general arrangement of the valve gear, etc., and the *Marchioness of Stafford* may be regarded as a standard London & North Western compound engine, about 40 of the type now being at work. The most distinctive single feature of Mr. WEBB's designs is that he uses no coupling rods but couples two high-pressure cylinders to the rear axle and the low pressure cylinder to the front axle. This radical innovation has certain great advantages, and certain great disadvantages likewise, which we have noted elsewhere.

The engine has two high-pressure cylinders, 14-in. diameter and 24-in stroke, attached to the outside frame plates between the middle and leading wheels, the connecting-rods working on to crank pins in the trailing wheels; and one low-pressure cylinder, 30-in. diameter and 24-in. stroke, placed between the main frames at the front end of the engine, the connecting-rod being attached to the single-throw crank of the middle pair of wheels. The driving wheels are 6 ft. 3 ins. diameter. The steam is supplied from a throttle valve in the dome to a T-pipe on the smoke-box tube plate, and thence by two 3¾ in. copper pipes, one down each side of the smoke-box, through the back plate of the low-pressure cylinder, and between the frames to the high-pressure cylinders. The exhaust steam is returned by two 5-in. pipes running parallel with the others into the smoke-box, and each pipe is carried round the inside of the smoke-box and enters the low-pressure steam chest on the opposite side. Thus the pipes themselves are of sufficient capacity to act as a steam receiver, and being placed in the manner described, the exhaust steam is superheated by the



Compound Express Locomotive, London & North Western Railway, F. W. WEBB, *Locomotive Superintendent.*

waste gas in the smoke-box, the final exhaust escaping on either side of the low-pressure steam chest, and thence into the chimney in the usual way, with this difference, that there is only half the number of blasts to urge the fire compared with the ordinary engines. Nevertheless the engine is said to steam very freely with the blast nozzle the same



Compound Express Locomotive, London & North Western Railway.
F. W. WEBB, *Locomotive Superintendent.*

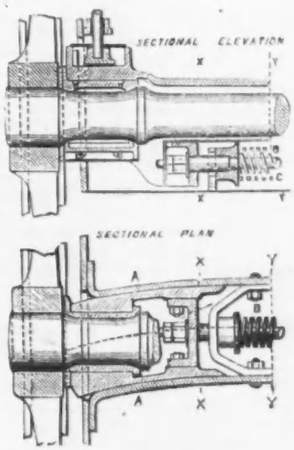
diameter as in the ordinary engines. An arrangement is also made so that steam direct from the boiler can be admitted to the low-pressure cylinder for use when starting; but a reducing valve is applied in connection with the steam chest, so that the pressure may never exceed about half that carried in the boiler.

The valve gear adopted for this engine is that known as Joy's (shown in outline in the accompanying cut) which does away with all eccentric rods, and considerably reduces the number and weight of the working parts. The reversing is effected by an arrangement designed by Mr. WEBB, by which both the high and low-pressure engines can be reversed simultaneously. One of the features of this class of engine is the adoption of a boiler in which the water space is carried under the fire-grate, so avoiding the necessity of a solid foundation ring. It also improves the circulation of the water and affords a better opportunity for washing out any sediment that may have collected in the bottom. The leading axle of the engine is fitted with Mr. WEBB's improved form of radial box, (shown in the accompanying cut), which allows a lateral movement of 1¼ ins. on each side of the centre line; the movement being controlled by a central spring, *B*. The axle-box, *The Engineer* states, has been extensively adopted, not only for engines, but also for the new carriage stock now being made for the London & North Western Railway. The axle journals throughout the engine have been made as long as possible.

The objects to be attained for which the compounds were expressly designed were, greater economy in the consumption of fuel, and the doing away with coupling rods and the double-throw crank, at the same time retaining the advantage of the weights on two pairs of wheels for adhesion, without the necessity of coupling them. It will be seen that the arrangement of this system allows the high and low pressure engines to work independently of each other, so that it is not necessary that the two pairs of driving wheels should be of exactly the same diameter, while the disposition of the cylinders practically balances the engine and enables it to run steady at very high speeds.

The locomotive *Marchioness of Stafford* was completed Feb. 28, 1885, and her designer and builder was awarded the gold medal for railway plant by the Executive Council. Nov. 30, she arrived back at Crewe, and on Dec. 17, 1885, commenced her working career, continuing in active service until Jan. 5, 1887, when she came into the workshops for repair, Feb. 22, she recommenced duty and remained steadily at work until March 27, 1888, when she was again laid up for 17 days; but, having undergone the requisite overhauling, was set to work and has been steadily employed to this date.

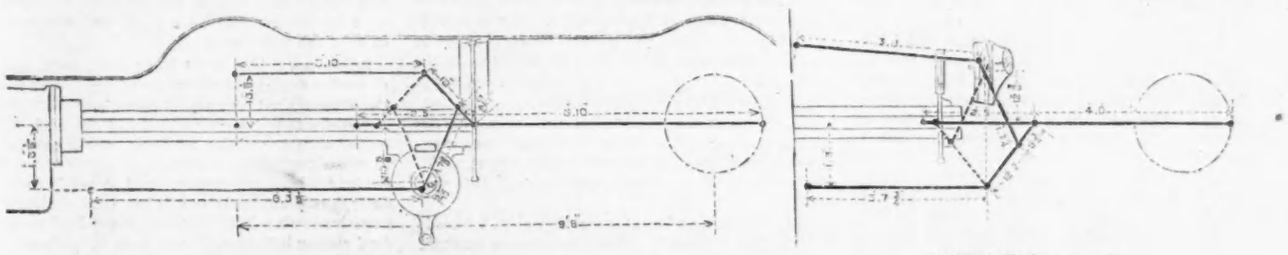
Between Dec. 17, 1885, and Nov. 30, 1888, she ran (1) 199 trips from Crewe to Carlisle and back, with a maximum load of 22 coaches and an average load of 13 coaches in both directions; (2) 218 trips from Crewe to London and back, with a maximum load of 20, and with an average load of 13 coaches; (3) 13 trips between various points with a maximum load of 16, and an average of 9 coaches; covering in all a distance of 132,970 miles, with a coal consumption of 36.3 lb. per mile, including that burnt whilst standing in steam, and in fact issued for *all* purposes. The average consumption of fuel of the forty of her class and dimensions has been 36.5 lb. per mile. The total miles run by the 74 compound engines now in use on the London & North Western system, since their introduction in 1882, amount to 10,396,389, and the average consumption of fuel by all types of these has been 32.6 lb. per mile, whilst the loads mentioned above may be taken as fairly typical. The average cost of maintenance compares very favorably with that of other classes, and in all respects the commercial results obtained with the compound engines on this system, up to the present time, have been very satisfactory, and have shown



Webb's Radial Axle Box.

to great advantage in the case of one of the ordinary type of Metropolitan engines, working on the District Railway, which was converted into a compound some time ago. This engine has run 161,335 miles, the average consumption of coal being 23.2 lb. per mile, including the usual allowance for raising steam. The average consumption of the same type of engine, non-compound, is 31.4 lb. per mile when doing similar work. Such comparisons of single engines with a whole class, however, are to be received with extreme caution. We have no belief that there is really any such difference as the figures imply.

In the earlier engines, the Joy gear for the outside cylinder was actuated partly by a small return crank fixed to the crank pin, but in all the engines of the *Marchioness of Stafford* type a different and better arrangement has been adopted, illustrated diagramatically by the accompanying engraving. To render the description complete, a diagram of the inside valve gear is given also, although it presents no abnormal features. The outside valve gear is not seen when the engine is at half stroke, the rods hiding each other.



Outside Cylinders. **Inside Cylinders.**

Joy Valve Gear, Webb Compound Locomotive.

The principle of Joy's gear consists in making a die slide up and down in an inclined slot. The valve rod is coupled by a link to the die, and as the die rises and falls, the valve is moved, one end of the inclined slot being nearer to the valve chest than the other. It will readily be understood that if the slot is placed vertically, there will be little or no motion of the valve, and according as the upper end of the slot is nearer to or further from the valve chest than the lower end, so will the engine run forward or backward. The engine, therefore, can be reversed by altering the position of the slot. In the engine illustrated, the slot is planed in a disc, as shown, which disc can be partly rotated in a hoop bored to receive it and secured to the engine

frame. The disc is turned round in the hoop by the reversing lever. The die is caused to rise and fall in the slot, by the system of linked bars shown, one end of one bar being pivoted to the connecting rod, so that the up-and-down motion of the rod is imitated on a reduced scale by the motion of the die in the slot. If the valve rod depended for its motion on the slot alone, there could be no lead. This difficulty is got over by the jointed rods in a way which will be readily understood by anyone who will take the trouble to follow out the diagram. *The Engineer* adds:

"It is almost superfluous to say that Mr. WEBB's compound engines are constructed with all that attention to detail for which CREWE is celebrated. The introduction and success of these engines reflects the greatest credit on Mr. WEBB, not only for his ingenuity as an inventor, and his skill as a designer, but for his energy and perseverence in working against a good deal of opposition, and a sufficiently noisy expression of doubt as to the excellence of the most thoroughgoing change in locomotive engine construction that has been effected since the Rocket superseded the Puffing Billy."

The Proposed St. Clair Tunnel.

The cross-section here given shows the proposed tunnel under the St. Clair river for the line of the Grand Trunk Railway. The present difficulties lie in the nature of the soft clay to be penetrated and the closeness to the tunnel roof of water-bearing material. Work was commenced on a trial heading by Gen. Wm. Sooy Smith & Son some time ago; but was abandoned on a failure to come to satisfactory terms with the railway company.

The present condition of the work is about as follows: On the Port Huron, or American, side the shaft is lined with brick 54 ft. down from the top and is excavated 8 ft. below tunnel grade. This shaft is 26 by 32 ft., timbered. A heading 6 ft. in diameter was driven 35 ft. from the shaft, but is now entirely filled again by the soft clay. The Grand Trunk Railway Co. is now at work over the American portal, and intends to make an open cut from the surface, 200 ft. square and with side slopes of 1½ to 1. The material is clay, with 10 to 14 ft. of fine sand on the surface. The depth to grade is about 53 ft.

At Sarnia, on the Canadian side, the shaft shown is lined with brick for 86 ft., but the lower 26 ft. is wrecked. Wm. Sooy Smith & Son, drove a 6 ft. heading from this shaft for 300 ft. west but stopped on encountering water and gas. The rock at this point is 114½ ft. from the surface. The clay on this side seems to have a tendency to move slowly towards the river and the river road has been moved back 60 ft. in the last 15 years to accommodate this push. The rock itself underlying the clay is Hudonion shale, valueless as a tunneling material.

On the east side also, the railway company is digging a "hopper" over the portal similar in its dimensions to the one on the American side, excepting that the depth to grade is 60 ft.

The present intention is to line the tunnel with a cast-iron shell, built up in the rear end of an advancing shield. White cast-iron will be used, in plates 5 ft. by 18 ins., 2 ins. thick, and provided with 6-in. flanges connected by ¾-in. bolts spaced about 5 ins. apart. Each tunnel segment weighs 1,000 lbs. Plans for the shield are not yet completed. When finished the tunnel will be made up of 2,300 ft. American approach, 2,200 ft. under the river, and 4,000 ft. Canadian approach. Mr. Jos. HOBSON is Resident Engineer of the Grand Trunk Railway and of the tunnel.

The Vesuvius Speed Test.

The wonderfully fast speed test of this new vessel on Jan. 11 has been briefly noted elsewhere. It surpasses all previous records of speed for vessels of any size whatever, especially as it was made, not on a "measured mile" but over a 5 knot course. As may be seen from the table in our issue of Jan. 12, the *Vesuvius* contract called for a vessel of 725 tons (really it is somewhat more) to carry an armament of three 15-in. dynamite guns, with a speed of 20 knots per hour.

The run was made over the official course of 2.543 knots, laid off outside the Delaware Breakwater. Going with wind and tide between the two buoys the cruiser made a speed of 22.947 knots, and on the return run, against wind and tide, 20.346 knots, or a mean speed for the two runs of 21.646 knots per hour. An indicated horse power of 4,295 was developed, independent of the auxiliary engines, and an approximate estimate of the latter would be not less than 150. A mean of 271.8½ revolutions per minute was obtained from an unvarying steam pressure of 160 lbs., the boilers working under forced draught.

The run was made in each direction over the course, so that the advantage gained one way from wind or tide would be counteracted by the same influence on the return. In each run the contract speed of 20 knots was exceeded.

On the 90 mile return trip to Philadelphia, 16 knots against wind and tide was made without any effort. The engines during the test were in charge of 10 machinists, with 2 skilled firemen in each of the 4 boiler rooms. The preliminary runs were made the day before to see how the vessel would behave under various conditions. In the first run, with low pressure and only natural draft, 10.6 knots were made with 125.3 revolutions. In the second, with higher pressure but natural draft, 14.88 knots was attained with 175.75 revs. per minute. In the third, with forced draft but low pressure, 18.94 knots was attained with 230.6 revolutions.

On the final test, the *Vesuvius* first ran over the course once for a warming up, the wind being westward, about 5 miles per hour; course lying S. 23° E. There was a slight ground swell on; the tide was ebb.

The test run then began; over the cabin, which is in the extreme stern, the vibration was very marked. A wave higher than the vessel's deck followed close astern, while well forward, on each quarter, the greatest depression could be observed in the water's surface. At the end of the run there was not a pound decrease in the steam pressure and everything was in readiness for the day's work, which resulted in placing an American built vessel at the head of the world's fleetest vessels. The most remarkable part of the performance of the *Vesuvius*, perhaps, was the obtaining of the result with the first machinery put into the vessel. In all records made abroad in measured mile trials screws and machinery have had to be replaced again and again. The *El Destructor* of the Spanish navy attained her speed only after seven different pairs of screws had been tried. The screws on Japan's fastest cruiser were changed time and again before her speed of nearly 20 knots was attained.

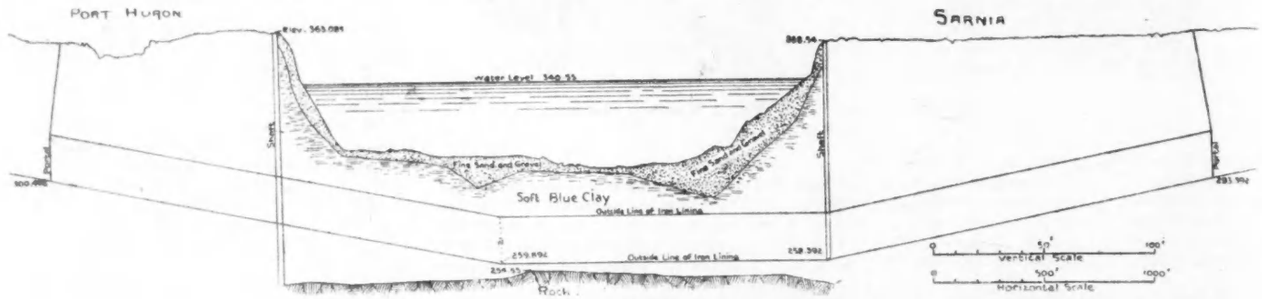
It appears almost incredible that over 4,200 H. P. should be developed in a vessel of some 750 tons. It is far ahead of all previous records. Another point which adds weight to the results obtained by the *Vesuvius*, is the fact that she carries an armament which exceeds by over 120 tons the armament carried by any of the torpedo vessels achieving fast speed. The weight of the armament on the cruiser is not less than 140 tons.

It was remarked by an officer who witnessed the trial, that six or eight such vessels as the *Vesuvius*, one in each of the six great seaports, would establish a most effectual coast defense by their presence, until the navy has been augmented sufficiently by the advent of new cruisers and battle ships to the active list.

In the former run of the *Vesuvius*, when between 20 and 21 knots was attained, the water was so shallow that a continual rolling wave fell on the stern of the cruiser reaching 10 ft. forward on the deck. The same effect was produced in the lower bay, when the vessel running at high rate steamed from the shallow anchorage ground out to the course; illustrating that vessels demand deep water for high speed. In the late test, instead of the water rushing in over the stern, she carried throughout the run a dry deck aft.

Proposed Bridge Law in Missouri.

The Engineers' Club of Kansas City, has been particularly active in advocating new and more stringent laws relating to the construction, maintenance and inspection of bridges, and like other engineering societies of the West has appointed a special committee to consider the subject. The Kansas City committee, made up of O. CHANUTE, J. A. L. WADDELL and W. H. BREITHAUPT, with W. B. KNIGHT as President of the club, has forwarded a memorial to the State Legislature of Missouri, and also has drafted an act "to promote the safety of bridges." The memorial cites a number of bridge failures in that State as showing the necessity for such legislation, and then in the act recommends in brief the following:



The Proposed St. Clair Tunnel; Cross-Section.

Before any bridge of 20 ft. or more span can be opened to traffic, the owner or owners must file in the office of the Secretary of State sufficient plans, strain sheets and statements of the strength of the bridge, together with a certificate under oath given by one of the bridge experts, to be provided for, that the bridge has been proportioned to safely carry its daily maximum load; that it has been designed in accordance with specifications recognized as standard among bridge engineers; that it has been built in strict accordance with the plans and strain sheets, and if a highway bridge, that it is provided with tablets at each end showing for what loading it is safe.

Every individual or corporation owning a bridge over 20 ft. clear span, must file, before Jan. 1, 1890, with the Secretary of State, a complete list of such bridges, giving location, character and length of each span. They must also before Jan. 1, 1892, file in the same office sufficient plans, strain sheets and detail drawings of each span of such bridges, together with a certificate from one of the bridge experts, showing the use, loading and strain on the bridge members.

The Governor of the State shall, from time to time, appoint, on satisfactory evidence, from among skilled engineers a sufficient number of men to be known as "bridge experts." The engineers may come from any State, but must possess all the necessary skill and experience and a high professional character. They shall exclusively exercise the right of certifying to plans, etc., as before referred to. They shall file a bond of $5,000 and take oath to faithfully

and impartially perform their duties. They shall pay an initial fee of $100 and $25 annually each, which sums are to form a special "bridge fund," out of which is to be paid the necessary expenses of making investigations.

The bridge experts shall be paid according to a schedule of maximum fees, approved from time to time by the Governor after consultation with the bridge experts. These experts may be suspended by the Governor, pending investigation, in case they prove remiss or unskilfull or make an erroneous statement. And on proof of charges the commission may be withdrawn.

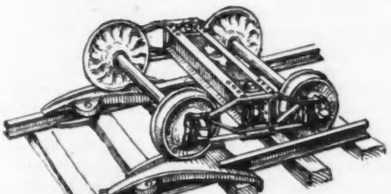
The Governor may at his discretion cause the plans and strain sheets of any bridge to be checked over by any other bridge experts than the one certifying to the same, and in case of deficiency found, cause the same to be remedied. Such reinspection of plans is to be paid out of the bridge fund mentioned.

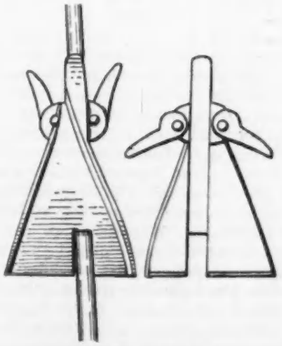
Any bridge reported to the Governor as unsafe may be examined by one of the bridge experts; provided the party making the report files a bond to pay all expenses of the examination if the charge proves unfounded. In case the owner of an unsafe bridge neglects to make the repairs required, it shall be the duty of the Governor to report the matter to the next General Assembly. In case of any serious bridge accident, it shall be at once officially investigated and reported upon, and this report sent to the General Assembly with such recommendations as the Governor may see fit to make.

The penalty for non-filing plans will be $10 per day; for non-filing lists, $2 per day; for non-filing general plans, $10 per day; failing to remedy deficiencies, $25 per day; failing to make bridge safe, $100 per day. All of these to be collected by the Attorney General of the State.

The Reed Car Replacer.

The device illustrated is what seems to us a very successful attempt to devise something better than the old portable frogs which are carried on every train, and are often exceedingly handy and effective, as it would be idle to deny, but which often likewise are very difficult to handle effectively, owing to the fact that they are not fastened to the rail, do not have a very effective bearing for their lower end, act only on one side of the rail, and leave the





The Reed Car Replacer.

wheel to make a very considerable drop downward upon the rail, which often fails to connect properly.

The device illustrated is of cast steel, and weighs 300 lbs. per set, or 150 lbs. each, being not too heavy to be easily handled. It is reported to us that in one instance 30 derailed cars at once, some on each side of the track, were successively replaced without moving the replacers. We tell the tale as 'twas told to us, never having seen such remarkable luck at any wreck. The price of the replacers is $45 per single pair, with a liberal discount for quantities. The top and bottom plan and perspective view which we give explain the design and use of the device so clearly as to require no further description.

Abstract of President's Address; Canadian Society of Civil Engineers.

The address of Mr. THOS. C. KEEFER is filled with interest, but as the available space is limited we must content ourselves with the following abstract:

The roll of Society membership extends from Halifax to Victoria. At the end of the second year of its existence, the Society numbers 542, made up of 2 Honorary Members, 259 members, 87 Associate Members, 47 Associates and 147 Students. There has been no lack of original papers on engineering subjects, to be read at the regular meetings, which have been well attended; and the records of the Transactions show that the discussions have been actively participated in, both in person and by correspondence.

After some further preliminary remarks, Mr. KEEFER commenced his address proper by referring to the recently constructed lock in the State of Michigan at the Sault Ste. Marie, opened for traffic in 1881, as follows:

This is the finest piece of hydraulic engineering I have ever seen, and deserves prominent mention. It combines both English and American practice, is well designed and executed, and altogether successful in operation. It reflects credit on the engineering staff of the United States Army under whose designs and supervision it was constructed.

The canal is 1 mile in length and 16 ft. in depth. The lock is at the lower end, and is 515 ft. long between the gates and 80 ft. wide in the chamber, with 17 ft. of water on the sills. The lift is 18 ft. more or less, according to the fall in the rapids between Lake Superior and Lake Huron. The gates are not set opposite to each other on the same axis, but on parallel axes 20 ft. apart, so that the width between the gates is reduced to 60 ft. while in the chamber it is 80 ft. the difference being met by reverse curves on either side.

Advantage is taken of the natural water power created by the lock, to establish by the side of it an "accumulator" for operating the gates and valves by hydraulic pressure—in the same manner as at the London and Liverpool docks—which works as a charm. The chamber is filled and emptied by culverts of large dimensions, under the mitre sills, without producing any disturbance of the vessel, because the tunnel or culvert runs the whole length of the chamber, with openings at the top, so arranged as to distribute the force of the in-flowing current along the center, entirely under the vessel's keel. In 1886 Mr. KEEFER timed the Canadian Pacific Railway steamer *Arthabaska* passing through the lock. It took 1½ minutes to close the upper gates, 7½ minutes to empty the lock, and 1½ minute to open the lower gates; altogether from the time of entering the lock, to the time of going out of it again, the passage was made in 13 minutes, and t ere was no hurry about it. No doubt, a single vessel, with dispatch, could be passed through the lock in less time than this.

It is only by the great initial pressure afforded by the accumulator, about 600 lbs. on the square inch, that the valves and gates could be commanded with so much ease and rapidity. This system has been 7 years in operation, and its efficiency proves the great care and skill with which all the details of construction have been wrought out. The lock was 6 years in building, and cost, including the enlargement of the canal, somewhere about $3,000,000. Besides this, there are two other locks, now called the "old locks," built by the State of Michigan, and first opened in 1855, which are still in use. These old locks are combined, having lifts of 9 ft. each to overcome the whole fall of 18 ft. The chambers are 350 ft. long, 70 ft. wide, and 12 ft. on the sills. The gates are suspended from pillars seated on the coping of the quoins, and the chambers are filled and emptied through the gates in the old-fashioned way. The old canal and locks were assumed by the U. S. government in 1881.

The registered tonnage passing through the old and new locks in 1886 amounted to upward of 4,000,000 tons, and it all passes free, both domestic and foreign. The staple articles of this commerce are, coal, copper, flour, grain, iron, ore, pig and manufactured iron, lumber, salt, silver ore and building stones. Before the opening of this canal, the commerce here was nil. It had its birth in 1855, and so astonishing has been its growth that it threatens soon to exceed the capacity of both locks, in view of which the United States Government has already commenced a second enlargement, the estimated cost of which reaches nearly $5,000,000.

This new lock is to occupy the site of the old combined locks, and is to surpass all other locks in the grandeur of its dimensions. It will have a chamber 800 ft. long between the gates, the width, both in the chamber and at the gates 100 ft. throughout, and the depth on the sills 21 ft. Of course there are no vessels on the upper lakes large enough to fill such a lock as this, but it is designed to pass a fleet at a single lockage—tugs with their tow of barges and craft of all sorts. The canal is to be deepened to 20 ft., and the same depth of channel throughout the rivers that connect the great lakes has been adopted as the ultimate aim of the U. S. Government improvements.

Canada has been slow in availing herself of her great opportunities at the Sault Ste. Marie. In 1852, Mr. KEEFER was sent there by the Government to survey for a canal on the Canadian shore, and although he found a most favorable line, and submitted plans and estimates, nothing further was done. The canal commission of 1871 recommended its construction, and yet no action was taken until last year, when the canal was surveyed by the Chief Engineer of the Department of Railways and Canals, and the works placed under contract.

There is to be one lock of 18 ft. lift to overcome the whole fall at the Rapids which varies from 17 or 18 ft. or more. It is to be constructed substantially according to the one on the opposite side of the river, and will be operated by hydraulic power in the same manner, but it will be somewhat longer. The chamber will be 600 ft. in length between the gates, 85 ft. wide, and narrowed at the gates to 60 ft. on opposite sides.

As an evidence of progress, reference may be made to the repeated enlargements of the more important works on the Welland and St. Lawrence navigation. The canals have been twice enlarged, the enlargement is in progress with the intention of providing a draft of 14 ft. throughout, and steady progress has been made in deepening the channel between Montreal and Quebec, until it has now reached a depth suitable for ocean steamers, of 27½ ft. at low water.

The Welland Canal, projected by the Hon. WILLIAM HAMILTON MERRITT, was begun by a private company in 1824, and opened in 1829. It was constructed under ALFRED BARRETT, their engineer. The locks were all of wood 110 x 22 x 8 ft. The wooden walls bulged out on either side of the chamber, and had to be hewn down from time to time to let the vessels pass.

In 1841, this work was assumed by the government, and the first enlargement was begun the same year under SAMUEL POWER, the resident engineer. The locks were made 150×26½×9 ft. of solid stone masonry, and are in use to this day. The canal was opened in 1845, but being yet unfinished when Mr. POWER resigned, it fell to the lot of Mr. KEEFER to carry on the works during the years 1846, 1847 and 1848, until recalled to headquarters. By raising the banks and lock walls the draft was increased to *ten* feet.

The second enlargement was begun in 1871, and completed in 1887. It was not that the volume of trade exceeded the capacity of the former enlargement, but because the locks were not large enough to pass the larger class of vessels, that at a cheaper rate were carrying the trade past the canal to Buffalo, and in order to cheapen traffic and secure a fair share of the Western trade, larger locks and a larger canal were absolutely necessary.

The Canal Commission, appointed in 1870 to report on the scale of navigation suitable for the canals, recommended the enlargement of the Welland and St. Lawrence Canals, for a draft of *twelve* feet, with locks 270×45×12 ft., and the enlargement was begun in 1871 on this scale; but before the work had far advanced, the Government decided the draft should be increased to *fourteen* feet, and as before stated, the Welland canal has been completed on this scale, and such of the locks as have been built on the St. Lawrence canals are of the same dimensions.

In referring to railroad engineering Mr. KEEFER spoke as follows of the change in rail material.

"The prestige and power of the railway system has been immensely increased by the substitution of steel rails for iron rails. The change has given great satisfaction to railway men, greater safety to travel, and greater economy in the transport of goods. Intense frost has more effect on iron than on steel, and sometimes plays havoc with iron rails. In my early experience at the first opening of the Grand Trunk, before the introduction of steel rails, we were always liable in winter to accidents from broken rails. I remember on one occasion, after a killing frost by night, followed by bright sunshine the next morning, no less than thirteen rails were broken between Brockville and Montreal, and a new Birkenhead with leading wheels did it. It was the bridge, or U rail, that was most liable to breakage, for the reason, as I imagined, that the hollow seat of the rail kept it cold, while the sun's action on the top warmed and expanded the top-bearing surface, and so the opposing forces of cold and heat weakened the rail. Since the introduction of steel rails we rarely hear of a broken rail.

The following reference was made to the Canadian Pacific Railway:

So much has been written of late on the subject of the Canadian Pacific Railway—it has been so well described—and such great credit awarded to the company for its enterprise and courage, its energy and perseverance in the prosecution of this great national railway, that it would seem as if the subject were exhausted, and there was nothing more to be said. Still there is room for a few remarks in reference to the present location of the line through the Rocky Mountains. There are cer-

tain defects on this portion, described by competent engineers, arising from hasty construction, and the necessity of opening the railway to traffic with the least possible delay, which limit the speed and capacity of trains over some 134 miles through the Rockies and Selkirks. The maximum ruling grade throughout the line east and west of these ranges is one per cent, whereas for six miles in the Kicking-Horse Pass the grade is 4½ per cent. To protect the track on the flanks of the Selkirk range, and in the Eagle Pass of the Gold Range, against snowslides and avalanches, about seven miles of heavy timber snowsheds have been constructed. Some of these form an artificial tunnel over the track, and are built of solid timber crib work at great cost. In order to protect these against fire, a complete system of fire protection afforded by abundant streams from the mountain sides has been established.

It cannot be supposed that our transcontinental highway can long be placed at a disadvantage by impediments to its traffic such as these just mentioned, especially if the through trade to the East ever reaches the important proportions expected of it. In its present condition the line will serve to develop the traffic, and when increased facilities are needed, there is no doubt that the resources of engineering skill will be adequate to provide them. This view of the case seems to have been recognized by the company when they referred to the location through the Rockies as a "temporary line."

Of the Grand Trunk Railway, Mr. KEEFER spoke as follows:

I have always entertained a special regard for the oldest of our main lines of railway, because in 1852 I left the Government service to take part in its construction under ALEXANDER MACKENZIE ROSS, the chief engineer. It was for the Government of that day that I made the location of the present line (then called the front line) between Kingston and Montreal, and it was on that location that the Grand Trunk Co. undertook to build it. I remained in the service of the company until it was completed and opened for traffic.

A very important work, in which this company is now engaged, is the doubling of their line of 333 miles between Montreal and Toronto, for which provision was made in the permanent abutments of the larger bridges at the first construction of the railway, more than 30 years ago. At the close of last year about one-third of this distance had been doubled, the curves eased, and the heavier grades reduced. The portion which I located for the Government between Montreal and Kingston was designed for maximum gradients of 1 in 200 going East, in the line of the heaviest traffic, and 1 in 100 going West; but afterwards, the grades both ways were made the same 1 in 100. The company is now coming back to the original design.

The doubling of the line was not begun one day too soon. Already they find the greatest benefit from the several sections now completed in the increased facilities for crossing trains. Trains that any hour in the day might be seen pocketed in the sidings all along the line, awaiting orders to proceed, are now set free, and the capacity of the line for the despatch of business greatly increased; when the whole line is doubled, the rolling stock can be much more profitably employed.

Another important work is the tunnel under the St. Clair river at Sarnia, to make a more complete connection between the Chicago and Grand Trunk in Michigan, and the great Western branch of the Grand Trunk in Ontario. It will require three miles of line to make this connection, one mile of which will be a tunnel, and half of that mile will be under the bed of the river. The company has already spent about $100,000 in driving an experimental heading to test the material through which it has to be made. To make sure work of it, the plan is to use shields, one sunk to grade at either portal, and both pushed forward by hydraulic presses until they meet in the middle. The shields to be 20 ft. diameter, each worked by 18 hydraulic presses. The work is conducted under Mr. HOBSON, M. Can. Soc. C. E., and Resident Engineer of the Great Western division. The shields and machinery are all prepared, the lighting of the works by electricity, the ventilation and pumping provided for, and everything ready to begin work.

In refering to Sanitary Engineering the statement was made that:

Mr. EDWIN CHADWICK, a leader of sanitary reforms in England, has lately said in Brighton, that it is not long since the death rate in London was 24 per 1000, and now it is but 14 or 15 per 1000; and he maintained that had the sanitary reforms been carried out according to the plans prepared, it might have been reduced to 12 per 1000. Referring to special classes he said that the death rate in the Guards, a quarter of a century ago, was 20 in 1000; it is now 6½ in 1000. In Germany the results are even better, the army death rate being from 5 to 6 per 1000. He states that in the large school districts of the Poor Law Unions, the chief diseases of children—measles, whooping cough, typhus, scarletina, and diptheria—are "practically abolished."

About a year ago there was published in the *Montreal Star* (Jan. 14, 1888) a list of twenty towns and cities in Canada, showing the populations and deaths, and the death rate per 1000. These twenty towns and cities had then an aggregate population of 653,047—the deaths 15,586, and the average death rate 25.40 per 1000. As we have no "Bills of Mortality," nor any vital statistics with which to compare these figures, it will be sufficient for my present purpose to assume them as approximately correct at the time they were made.

Thus comparing the twenty modern towns and cities enumerated, with the ancient historical and densely populated city of London, in which there are as many people now living as there are in all Canada, it might reasonably be expected that the mortality in these Canadian localities could, by strict sanitation, be reduced to a par with that of London, in which case fully 6,000 lives might annually be saved to the country in these places alone. But when we take these several places in detail we find some startling revelations. The lowest rate of mortality is found in the inland towns and cities of Ontario. These towns are Belleville, Guelph, Chatham, Galt, Peterborough, ranging from 16.50 to 19.75 per 1000. The cities are London, Kingston, Hamilton, Toronto, ranging from 18.31 to 21.50 per 1000. Halifax shows 20.52, Ottawa 28.70, Montreal 27.99, Quebec 34.57, Three Rivers 32.10, Sherbrooke 27.37, and saddest of all, St. Hyacinthe 41.83, and Sorel 44.88 per 1000! There is cause for serious reflection in these figures, showing what a heavy responsibility rests with the Boards of Hearth in all larger cities and towns. I have gone into these details in order to prove to the Sanitary Engineer that there is in Canada plenty of important work for him to do.

Mr. KEEFER spoke of the recent failure of the suspension bridge at Niagara Falls as follows:

The members of this Society will be glad I am sure to be informed of the circumstances connected with the recent failure of the Suspension Bridge at Niagara Falls, which I constructed for the bridge companies, and which was opened for traffic on January 4, 1869, just 20 years ago. All the particulars relative to the first construction of this bridge were published in a report made by me to the Directors, dated March 1, 1869, and this report with illustrations was the same year given in *Engineering* in England.

The span of this bridge is 1268 ft. between the points of suspension at the towers. The roadway was 10 ft. wide, providing a single track for carriages, and a path for foot passengers. The roadway was supported by two cables, each cable composed of 7 wire ropes, each rope of 7 strands, each strand of miniature wires 0.155-in. in diameter, No. 9, B. W. G. Each rope had a guaranteed tensile strength of 100 gross tons = 112 tons net. They bore the test of 108 tons net without rupture of the rope, when the fastenings gave way.

The single track bridge was designed to carry with perfect safety a load of 100 tons without producing a strain of more than 25 per cent. of the ultimate strength. Besides the cables there are over-floor stays which are a real support to the roadway; and in order to keep the roadway from swaying about in the wind, there were 54 guys, 28 of which were on the upstream, and 26 on the down stream side. Some months after the bridge was opened, there was added both on the up stream and down stream side a horizontal arched cable, with horizontal stays between them and the roadway, which had a good effect in steadying the bridge. The original bridge rested on wooden towers, but for fear of accidents by fire the directors substituted steel towers for wood.

About two years ago the Directors decided to make the bridge a double track bridge without consulting me in the matter. They proceeded to take down my single track roadway, and to substitute a double track. This enlargement was completed in September last. I have not seen any of their work, and from the lack of information I am unable to state what means were adopted by them to secure the double track against the additional strains that must come upon it; the additional strain on the cables and stays, and the additional surface offered to the force of the wind, for which more guys would have to be provided.

My bridge, before it was opened to the public, was officially inspected by officers of the Dominion, and of the State of New York; the Directors also employed the Hon. W. J. MCALPINE, their consulting engineer, to report more fully in regard to its sufficiency. My bridge weathered the storms for 20 years. My cables and anchorages are still in place, and, I understand, are to be used in the reconstruction of the bridge. My roadway was not blown from the cables, it was taken down by the bridge company. It was the double track roadway substituted for the single track that was blown away only three months after it was put up; and I am not aware that there was any Government inspection of it. It is a fortunate circumstance that no lives were lost in this accident. From all accounts it was a terrible storm. The anemometer at Buffalo registered the velocity of the wind as 88 miles an hour.

The great problem to be solved in the construction of a bridge over this chasm is to keep it from being injuriously affected by wind storms which not only cause vibrations like that of a pendulum, but wavelike undulation through the length of the roadway and the suspended portion of the cables. To guard against these a cradle form is given to the cable and the over-floor stays from the towers to the roadway, as well as the cradle stays from the cables to the base of the towers, seem to check these undulations, while the under-floor guys reaching down at various angles from the roadway to the rocks along the river bank, meet and check the lateral force of the wind upon the whole suspended system. To balance these forces one against the other, and leave a fair margin for safety, will tax the best skill of the engineer, because the storms through this gorge seem to drive with greatest fury in consequence of its funnel shape.

An opinion was expressed by the late J. A. ROEBLING, who built the railway suspension below this, that no bridge could be made to stand here at the falls; not on account of the storms, but from the spray coming from the American Fall, which would cover the bridge with ice and break it down. But the experience of 20 years has proved there is no danger to be apprehended from this cause. In deference however to his opinion the bridge was made a tentative structure, and if successful might afterwards be enlarged and made a permanent structure.

Ship-Building on the Clyde in 1888.

In an exhaustive article on the Clyde ship-building during 1888, the Glasgow *Herald* remarks that in the various ship-building yards, which may comprehensively be regarded as being located on the Clyde, there have been built during the past year 302 vessels, aggregating 280,037 tons, including 175 steamers of 228,850 tons. The preference given to steel in the construction of vessels has again greatly increased, this year the number built of that material being 238, aggregating 269,480 tons; while only 52 vessels, aggregating 8,718 tons, were built of iron, and only 12, aggregating 1,849 tons, of composite and wood. Last year the number of vessels built was 326, with a total tonnage of 185,362, of which 303 were steamers of 147,537 tons, and 123 were sailing ships of 37,525 tons. Of these, 194, aggregating 148,569 tons, were constructed of steel; 46, representing 36,186 tons were of iron; and 86, totalling 507 tons, were of wood. There is, therefore, a decrease for the year now closing of 24 in the number of ships built, and an increase of 94,675 tons in the tonnage. The sailing ships constructed this year show an increase in number of four over last year and an increase in tonnage of 13,662; while the steamers show a decrease in number of 28, but an increase in tonnage of 81,228. From these statistics it would appear that the increased number of sailing ships includes a number of small craft of trifling importance. From the foregoing figures it will be seen that greatly increased activity has prevailed among the ship-building yards on the Clyde compared with 1887; and, indeed, the output is the largest since 1884, when the total was 296,854 tons. Still, however, it falls considerably short of the output from the Clyde in the prosperous years of 1881-2-3; but, as it exceeds the total of any year before that, the substantial increase over last year may be an indication that another term of prosperity has set in.

THE LEAD YIELD for the past 5 years, is set forth in an exhaustive article in the N. Y. *Financial and Mining Review*, of recent date. The total output from 1883 to 1887 inclusive is put down at about 700,000 short tons, valued at $60,575,000, and of this total 84.8 per cent. was desilverized, or lead from silver bearing ores. The remainder was from pure galena ores. In 1887, January to June, the average highest price paid was 4.52 cts., and the lowest 4.27½ cts. per pound. The average highest price in London for English lead was 2.863 cts., and for Spanish lead, 2.804 cts. per pound. The total output of American lead for 1887 was 160,700 tons. Of this amount Utah mined 22,838 tons; Nevada 3,400 tons; Colorado, 11,000 tons; Idaho, 20,000 tons, the remainder coming from various other States and territories. There were imported from Mexico across our borders 15,488 tons, chiefly from the mines in Coahuila.

LAKE TAHOE is recommended by Major POWELL, of the Geological Survey, as a great natural storage reservoir for irrigation purposes. He says that with its catchment basin of 500 sq. miles it can abundantly irrigate 50,000 acres of land, and only needs to be tapped and have gateways constructed to be at once available.

The Lobnitz Rock Dredge.

We gave some months ago a general description of this rock-crusher and dredger and some of the results of the first trials made by its builders at Renfrew, Scotland. But a late issue of *Le Genie Civil* shows the longitudinal section, reproduced here, and gives some additional information, from which we make the following abstract:

The purpose of the *Derogheuse* is the removal of rock under water by first breaking it into blocks of convenient size and then lifting these to the surface by a strong chain of buckets. It was designed for special work in connection with widening and deepening the Suez Canal.

The dredging appliance is of the usual type, saving only that it is made unusually strong in all its details. The novel feature lies solely in the system of rock breakers attached to the dredge. The latter consists of 10 heavy metal picks, arranged 5 on each side of the bucket-carrier in the dredging well, as shown in the figure. These picks are each 41 ft. long and have a steel cutting-edge of ogival shape. They move in guides, and are lifted to the requisite height by chains operated by hydraulic presses. The chain carriers, with other machinery, occupy a sort of metallic belfry surmounting the dredge.

The cutters each weigh about 4 tons, and the hydraulic engines have a lifting capacity of 6 tons each, and these latter work under a water pressure of 100 lbs. per sq. in. They are operated by two men working appropriate levers. The entire battery of picks can be moved longitudinally along the dredge-well, on slides or tracks, by a special engine. It is possible with the arrangement described to strike 8 or 10 blows per minute; and in actual practice to make each battery of 5 picks strike from 200 to 300 blows per hour.

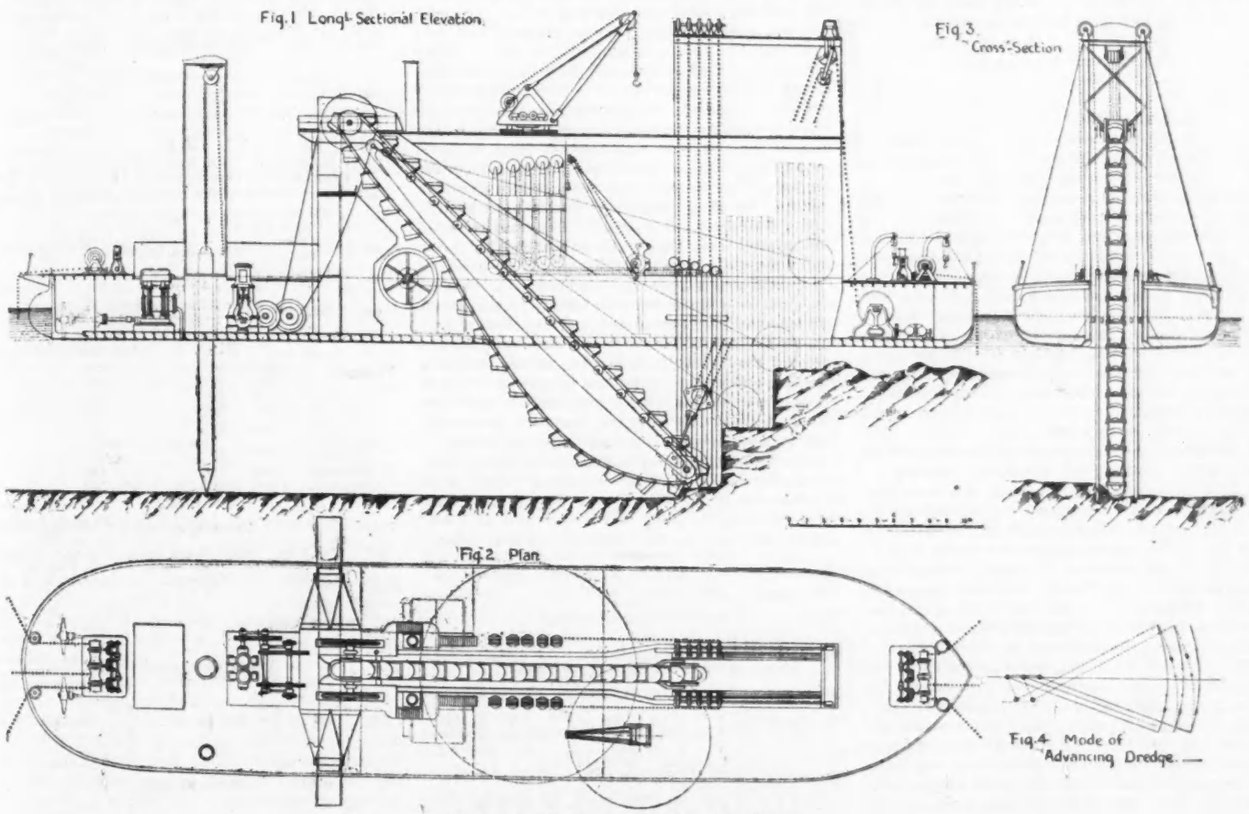
The vessel carrying this machinery is about 183 ft. long, 41 ft. beam, and has a draft of 12.2 ft. The hull is subdivided into 18 water-tight compartments. The engine operating the dredging buckets is a double compound machine of 200 H. P. This power is transmitted to the bucket-chain by steel chains, with an intermediate friction gearing which prevents rupture of the bucket system when the resistance below is too great. Except in their dimensions and extraordinary strength, the buckets, etc., do not differ from the ordinary practice.

This machine is operated as follows: In the rear of the hull is a well containing a vertical steel pivoting pile, 3 ft. in diameter, which can be dropped or lifted at will; chains running to the right and left of the bow permit the dredge to describe the arc of a circle around the pivot pile as a center. When the maximum sweep is reached, a second smaller pile can be dropped to the right, but directly opposite the first (See Fig. 2), and the return cut made on a new center and in advance of the first arc. It is the same scheme adopted some years ago in the Slaven dredges of the "Hercules" type used on the Panama Canal. In addition to the appliances already described, this dredge is furnished with an outfit of special cranes for mounting and unmounting the picks, etc., and a special engine of 300 H. P. for a detachable screw to be used in propelling the vessel to any desired part of the globe.

When the dredge is in position for working, the battery of picks is adjusted in accordance with the depth of water and the work to be done, so that they will always strike the rock alongside of the dredging buckets. The speed of the dredging engine is regulated by the hardness of the rock and the time required, as found by experience, to reduce the rock to fragments sufficiently small to be handled by the buckets. If properly regulated, the buckets continually remove the broken fragments and leave the bare rock exposed to the attack of the falling picks.

In the trial made at Greenock, Scotland, with new machinery, and under the unfavorable conditions of short days and winter weather, this dredge in 38¾ hours—spread over 10 days—loosened and lifted 1,660 tons of rock, or about 42.8 tons per working hour. The character of the rock is not given. When at work on a slope or in steps, as shown in Fig. 1, it is confidently expected that it can remove from 200 to 300 tons in a working day of 10 hours.

The plan to be pursued at Suez is about as follows: The picks will be made to strike points about 2 ft. distant one from the other, and the face of the rock will thus be cut into a series of three steps for every 6½ ft. of advance. Experience proves that the weight of the picks might be with advantage increased above 4 tons each. In six months of work only two picks were broken, and each of these breakages only delayed progress about 2 hours, as extra picks were held in reserve. At Port Tewfik the rock is found about 13 ft. below the water surface. The rock to be handled differs; at Chalouf it is a sort of calcareous conglomerate, while at Tewfik it is softer. The points of the picks do not lose their temper at work; but while they were originally forged at an angle of 70°, they wore down to about 43°. The force required on the dredge is 26 men, 18 belonging to the work of the dredge proper. Of the other 8 men, 2 men manœuvre the boat, 4 are stationed in the belfry and 2 attend to the general machinery.



The Lobnitz Rock-Breaking Dredge.

EXPERIENCE WITH M. C. B. STANDARD COUPLERS ON THE SANTA FÉ SYSTEM.—The A. T. & S. F. Ry. has had in use probably more cars fitted with the Master Car-Builders' standard coupler than any other western road, and has, therefore, probably had more experience with such couplers than almost any other road in this country in connection with long and heavy trains hauled over steep grades. The result of this experience has established the fact that any coupler, of the Master Car-Builders' type, will, by reason of its close coupling and automatic action, more than pay for itself in a decrease of losses resulting from the breakages of trains and damages paid to employés, even if such couplers be unable to withstand all the shocks of trains in heavy service. The experience of the Santa Fé road is peculiar in many respects. They have had a large number of cars fitted with automatic air brakes, and at the same time fitted with the automatic couplers. A peculiarity in the automatic draw-bar which they have had in use resulted in more failures after it was put in use than was anticipated. In short, the experience of the Santa Fé company has been that which will be derived from a combination of the quick-acting air brake, ordinary Master Car-Builders' standard couplers and heavy through trains. The conclusions drawn from this experience, in spite of the failures of the draw bars, are, that the automatic couplers, if they are of any reasonable strength and reliability, and can withstand the ordinary shocks of railroading and even a limited amount of wear, will soon pay for the expense of their adoption, where the service rendered by the freight trains is heavy, fast, and on a road where the gradients and curves render danger from breakages particularly great.—*Railway Review.*

Australian Railways.

The following table is taken from the London *Railway Press*; the expenditure per mile includes rolling stock and plant. The gauges are as follows: New South Wales, 4 ft. 8½ ins.; Victoria, 5 ft. 3 ins.; Queensland, 3 ft. 6 ins.; South Australia, 3 ft. 6 ins. and 5 ft. 3 ins.; New Zealand, 3 ft. 6 ins.

Colony	Date of Latest Return	Miles Open	Capital Expended	Cost (in dollars)		Miles opened per 1000 of Population (Estimated)
				Per Mile	Per head of Population (Estimated)	
New South Wales	Dec. 31, 1887	2,036	132,660,000	65,155	126.00	1 75-80
Victoria	June 30, 1888	2,018	130,600,000	64,715	123.50	1 73-80
Queensland	Dec. 31, 1887	1,765	56,600,000	32,070	157 50	4 73-80
South Australia	June 30, 1888	1,420	45,415,000	31,970	138.00	4 26-80
New Zealand	March 31, 1888	1,758	65,085,000	37,025	105.00	2 67-80

Underground Blasting Operations.

At a late meeting of the North Staffordshire Institute of Mining and Mechanical Engineers, Mr. HENRY JOHNSON, F. G. S., M. S. A., contributed a paper on "Underground blasting operations, with special reference to blown-out shots and their prevention."

Having referred to the importance attached to the question of blasting, and to the fact that many explosions owed their origin to the improper application of explosives and to blown-out shots, often attributable to laxity of management in the past, Mr. JOHNSON submitted that maximum safety and success could only be attained by limiting the operation of blasting to qualified workmen, aided by the adoption of an explosive and the means of applying it, which, combined, should be safe, effective, and economical. Having detailed the various causes of inefficient blasting, he said it was with a desire to remedy those defects that he had given attention to this subject. He did not submit his suggestions and operations as a sovereign remedy for all the ills attending blasting, but he contended they were capable of doing some good.

He proceeded to consider the question under four heads, namely, making the bore-hole, cleansing the bore-hole, tamping, and ramming. He described the construction of the common hand-punch at present in use and the difficulties connected with the use of it. By his improvements he claimed to have remedied all the defects. He made the bar portion with discs or guides with rounded edges of a diameter somewhat less than the width of the bit. These discs supported the bar and bit in a central position when in the hole and acted as guides to the bit. One end of the bar was constructed to receive the bit, which was attached by means of the ordinary plug and socket screw joint usually attached to ordinary boring-rods. For making the first part of the bore-hole, a short, light punch might be used, with discs or guides closer together. On inserting the longer punch after the shorter one, the discs give it a central bearing and guidance, in addition to which the weight against the operator was *nil*, the *modus operandi* being simply a forward and backward, and, at the same time, slightly circular movement.

He had himself demonstrated by actual working that such a hand-punch could make a perfectly straight and circular hole with ease. It could be worked in places and positions quite impracticable for drilling machines, such as up or down vertical holes. The "cheese-cutter" bit might be worked to advantage in conjunction with his improved bar. It had been used with success in the hardest portion of the thick coal of South Staffordshire, and also in bind and soft rock.

Having described his improved cleanser, he observed that very often most unsuitable and improper tamping was used when clay could not be readily procured, and he submitted that this improved clay cartridge removed every existing difficulty in this respect. With regard to ramming the bore-holes, he urged that the common rammer was unsuitable for pushing tamping up into a compact and sound barrier against the explosive. His improved rammer consisted of a shaft carrying a head at one or both ends of a diameter slightly less than that of the bore-hole and equal to that of the tamping cartridge, the head having a center hole for passage of fuse. In ramming a hole, the fuse leading from the explosive cartridge passed through the central hole of the tamping cartridge, then through the central hole of rammer head, and was held to the top at the mouth of the hole. In this manner the tamping cartridges were easily pushed into position, and there broken up and perfectly rammed, the fuse or cable being completely built in the center of the tamping, the pressure brought to bear being equally distributed at each blow of the hammer.

Very successful results had been obtained with the tamping cartridge alone rammed as above described, demonstrating that a properly and perfectly tamped and rammed bore-hole under ordinary conditions was secure against a blown-out shot. But as a means of preventing a blown-out shot under any conditions, he inserted into the bore-hole after and against the tamping a metallic plug-wedge tapered from one end, which nearly fitted the hole, to the other end, on which was formed a head for the purpose of carrying into the bore-hole two side wedges. The plug-wedge had a central hole through which the fuse or cable passed. The complete plug and wedges were then pushed into position, after which the whole were locked by simply pushing the side wedges with a specially designed rod. Several tests had been made, which, properly prepared and carried out, had proved conclusively that it was impossible to obtain a blown-out shot, even from a fast and hard rock, from a hole punched, tamped, rammed, and wedged as he had described. Having supplied particulars of a few experiments with the plug and wedges, he observed that as a preventive against withdrawing a charge after a misfire (a thing often clandestinely done) the plug and wedges were unimpeachable; for it was utterly impossible to withdraw them if once they were locked, and this capacity of the plug and wedges was of itself a sufficient reason for their adoption in fiery mines.

List of Errata in the Economic Theory of Railway Location.

(*Concluded from Page 514.*)

734—last line: *for* 241 *read* 241'.
741—Table 195, last sentence of note; *for* dividing col. 5 by $2,400 *read* dividing $2,400 by col. 5.
741—2d line under table, *for* 11.7 *read* $\frac{11}{7}$.
745—Table 197 at bottom of Col. 6 | *for* | Col. 5—No. in line below of Col. 2 | *read* | No. in line below of Col 2—Col. 5.
746—table "Rock Cutting", *for* 23 *read* 2.3
757—2d col. of table, *for* 61.1 *read* 6.1.
761—l. 23 *for* are *read* is.
781—8th line of par. 1052, first word. *for* turning *read* burning.
797—l. 22, *for* foreman *read* fireman.
820—end 6th line, *for* ton *read* cwt.
833—5th line of par. 1131, *for* file *read* fill.
841—3d line of 3d par, *for* above Fort Benton *read* below.
854—end of 1st par., *for* Fig. 292 *read* 277.
865—4th line from end par. 1188, *insert* is *to read* As it *is* always.
884—5th line, *for* semicolon *substitute* a comma.
886—end 1st par. of 1243, *for* Fig. 208, *read* 298.
901—3d line of 2d par1272, *for* weights *read* heights.
915—l. 14 from bottom, *for* 10 times *read* one-tenth.
934—Note l. 10 from bottom, *for* due for *read* due to.

List of Errata in the *Third* (and all preceding) revised editions of "The Economic Theory of the Location of Railways" which will be corrected in the *Fourth* edition. Readers aware of further errata will kindly report them.

PAGE	LINE	FOR	READ
42	3d above table	1890	1900
48	7 of § 38.	locomotives	locomotive
55	7	level	lowest
"	14	slighest	slightest
"	last	if	in
65	7 of § 65.	town	towns
215	heading of table.	PAGE 122	PAGE 212
230	Figs. 5 and 12	Make lower of the two *B's* in right upper corner read *B'* and in Fig. 12 the lower of the two *A's* in left upper corner read *A'*.	
304	8	*OAB*	*OAC*
316	5	little	a little
320	2	the railroads	steel rails
326	2	C. Whinery	S. Whinery
334	5th of § 375	acutal	actual
347	13	additionto	addition to
348	top	20—50—40—50 (in end scale of cut)	20—30—40—50
380	8 from bot.	proportions of the grade near	proportion of the grade wear
389	Fig. 93 and col. under it.	96.9 / 96.8	96.8 / 96.8
		and decrease column headed "Elevations" each 0.1.	
405	14	Fig. 89	Fig. 97
409	6 from bot.	$\frac{x}{y}$	$\frac{x}{y}$ to $\frac{x}{y}$
"	10 " "		
421	6	"in 1834, before the trial of the Rocket had taken place"	"in 1830, soon after the trial of the Rocket took place."
"	foot-note	Add this sentence "The equalizing lever has been claimed as the invention of Mr. Thomas Rogers, who probably was an original inventor, but Winans seems to have antedated him."	
440	6–7	assumed adhesion of 1 / assumed adhesion of 1.	assumed adhesion of ⅓ / assumed adhesion of ¼
446	11 from bot.	even the	even if the
447	9 of § 545	Figs. 101-108	Figs. 109-116
452	formula	load on drivers / × coeff. adhesion	take out the line under "load on drivers."
456	4	143	144
456	4	Table 143	Table 144
457	5	last	best
459	last	(Table 100) $1191 HU$	(Table 143) $1221 HU$
460	3	$\frac{74.09}{1191} = 6.22$; $\frac{82.9}{1191} = 6.96$	$\frac{74.09}{1221} = 6.07$; $\frac{82.9}{1211} = 6.79$
464	last §	result	results
466	heading of table	On Track 73'86'73'86'73'86	On Truck '73,'86'73,'86 '73'86
479	9	average cylinder	average pressure
486	1st col. table	34' 18½"	34' 8½"
490	5-6 from bot.	strike out all after	"Hammer, 8,000 lbs."
498	3d above § 617	deed	need
499	bottom	The following table to be added in the space left blank for it.	

		Av. Speed Miles.	Resistance Lbs. per Ton.	
Tangent	1886	16½	6.62	
	1887	13¾	7.90	7.26
3° Curve	1886	22½	8.46	
	1887	16¼	9.60	9.03
Lowest observed on Tangent.	1886	20½	4.32	
	1887	15	5.87	
Highest observed.	1886	11¾	8.50	
	1887	14¼	7.51	

503	last	Tro sième	Troisième
517	"	June 11, 25, 1880	June 11, July 16, 1880
518	7 of § 654	some 55 per cent.	some 45 per cent.
527	1	Fig. 114	Fig. 123
"	4 of § 661	Table 151	Table 166
537	1	as t' t''	t' or t''
"	6 from last	$\frac{w}{g}$	$\frac{W'}{g}$
"	5 " "	is given numerically, etc.	may be deduced for any grade from Table 119, p. 341
538	6	$\frac{w}{g}$ and $\sqrt{d^2+h^2}$	$\frac{W}{g}$ and $\sqrt{d^2+r^2}$
	next	formula to read	$s-r=\frac{r^2}{2d}$ $s=\frac{r^2}{2d}+r.$
560	6	cheapest	cheaper
562	last	$d\,x^2$	$d\,(x^2)$
605	10 from bot	$354,000 × 105 = $371,700	$354,000×1.05= etc.
614	3 " "	less with	weigh less
640	1	10	1.0
734	15	*B C*	*A C*
741	last of note	Column 5 by $2,400	$2,400 by Column 5.
906	1 from last	I speak	"I speak

Railways in the Philippine Islands.

ALEX. R. WEBB, U. S. Consul at Manila, sends the Department of State an interesting account of the opening of the first railway built in the Philippine archipelago. It is a narrow gauge road connecting Manila with Malabon. In the construction, iron rails have been laid with gravel ballast. One large stream and two small ones are crossed by substantially built stone bridges. The entire equipment, says Mr. WEBB, comes from German and English factories, and it might just as well have been supplied by American manufacturers, if a proper effort had been made to accomplish that end. At Malabon there is no depot, but the conductor of each train sits by the roadside and sells tickets over a small table until just before the train starts, when he blows a horn as a signal to start, and steps on board. Mr. WEBB further says:

"The patronage so far has been a surprise to the company, and there seems to be no doubt that the enterprise will pay handsomely. The road passes through a most beautiful region, presenting a tropical landscape as rich and fair as ever the eye rested upon, and the revenue from those who make the trip for recreation will undoubtedly be very large. The past two Sundays the cars have been literally packed with passengers, and the new railroad is looked upon as a sure success.

"The auspicious opening of the road has aroused an unusual degree of interest in railway matters among business men here, and quite a number of new lines to various parts of this island (Luzon) are being built on paper. A project which finds much much favor is a proposed line from Manila to Cavite, the naval port which faces the entrance to Manila Bay, on the southeast shore. This is a very important port, and communication between it and Manila is had only by means of a small steamer which makes two or three trips daily. A railway line connecting the two ports would be about 30 or 35 miles in length, and it is quite confidently felt that it would be a very remunerative enterprise." It is probable that in view of its military and naval interests, the Spanish Goverment could be induced to make a very liberal concession to such a project.

"For the next few years there will undoubtedly be a rare field in the Philippines, not only for the sale of American railway supplies and rolling stock, but for the investment of American capital in railway enterprises. It has been demonstrated by Spanish and English capitalists that a street-car line and a narrow gauge railway can be built and operated profitably in and near Manila, and public interest is fairly aroused upon the subject of railways as investments. There is apparently no good reason who the Philippine Archipelago, with more than 7,000,000 inhabitants, a vast expanse of rich and productive territory, and a rapidly increasing commerce with all parts of the world, should not have at least four or five well-built railways paying large dividends. This is the idea that is now being generally discussed here, and this discussion will, no doubt, be productive of results, the profits and general advantages of which American capitalists and manufacturers may share if they will make proper efforts.

"The work of constructing the Manila & Dagupan Railway, 120 miles in length, is progressing rapidly and satisfactorily, but work has not yet been commenced on the proposed line from this city to Antipoli, 18 miles. I have as yet heard of no American having any connection, near or remote, with railway projects here."—St. Louis *Globe Democrat.*

ATMOSPHERIC RESISTANCE OF PAINT.—Experiments made under the direction of the Dutch State railways with various plates are reported to have proved that the red lead paints resist atmospheric influence much better than those of brown-red and iron oxides. The red lead paints adhered closer to the metal and possessed greater elasticity than the others. It was also found that better results were obtained if, before the paints were applied, the plates were pickled instead of being merely scraped and brushed. The test plates were pickled in muriatic acid, washed with water, thoroughly dried, and, while warm, carefully oiled. As iron and steel are peculiarly liable to corrosion when in salt water, vessels made of them require special protection. This can be given by covering the metal with some alkaline or basic substance, or oxide of some metal electro-positive to it. Caustic lime and soda are very efficient for this purpose, and act equally well when made into a paint with oil; but their efficiency is destroyed when they cease to be caustic or when they are saturated with carbonic acid, which they absorb freely from the air. Magnesia is equally efficient, and does not absorb carbonic acid. It therefore makes as good material for a paint as could be desired; and, moreover, forms an excellent basis on which to lay an anti-fouling paint, which it protects from the galvanic action of the iron by insulating it, while it does not affect the anti-fouling qualities.

A WALNUT ST. BRIDGE, over the Schuylkill river in Philadelphia, is again under discussion in the City Councils, but with no immediate promise of beginning any work.

Taylor's Stake Tacks.

This ingenious and meritorious little device consists simply of an ordinary tack with a little thicker head than usual, and with a little indentation in the center of the head. In this indentation, the point of the sight-pole can be readily placed and can be relied on to stay there without any care. They are sold in 2 oz. to 10 lb. boxes for the very trifling price of 18 cts. (by mail) to $6, and no sensible engineer will use any other kind of tack for field work. They no longer leave any excuse for driving a tack down too far into the wood, which in a short time swells over the tack, making it very difficult to find. The better way is to leave the tack standing up slightly above the wood when first driven, as it always swells up afterwards. The accompanying cut shows the tack full size. The tacks are being introduced and sold by Messrs. Young & Sons, of Philadelphia, and we presume by other dealers.

ENGINEERS' STAKE-TACK.

The Pullman Company's Deal.

The Pullman Palace Car Company has at last absorbed all its competitors with the sole exception of the Wagner Company, whose cars run on all the lines of the Vanderbilt system. On Jan. 23, the deal was consummated by which the lately organized Union Palace Car Company was sold outright to the Pullman Company. The Union Palace Car Company was formed by a consolidation of the Mann and Woodruff companies a few months ago, and was designed to operate over the New Jersey Central, Philadelphia & Reading, and the principal Southern railways, which territory will now be served by the Pullman Company.

The traveling public has, on the whole, been better and more reasonably served by the Pullman Company than by any of its rivals, and the consolidation is probably a good thing for the public. If there were any tendency for the company to grow lax in the quality of its service or extortionate in its rates, the influence of State Commissions and Legislatures, which have shown a disposition of late to regulate these matters, would doubtless be sufficient to counteract it. Besides this it is to be remembered that the railway companies are continually improving the accommodations which are offered to the passenger without extra charge. Chair cars for day travel and plainly furnished sleeping cars to accommodate those who cannot well afford the luxury of a Pullman are destined to become more and more common, while improved seats, larger windows, and better lighting and heating facilities are continually increasing the comfort and safety of the traveler in the ordinary day coach. The Pullman Company will have to keep on improving, and if necessary cheapening the accommodations which it offers, in order to keep its revenues.

There is every reason to believe that it will do this, for there are few private corporations, in this country at least, which have shown more progressive enterprise and readiness to adopt new improvements than the Pullman Company. The experience of the railway companies which have tried the plan of running parlor and sleeping coaches of their own seems to prove that it is more profitable for them on the whole to let the business to the Pullman Company. There is every reason to believe, therefore that the company has a profitable future before it.

THE WESTINGHOUSE FRICTION BUFFER was submitted to a test at Pittsburg, last week, by arranging a collision of freight cars moving at a speed of 30 miles per hour. The essential feature of this device is that friction is developed between interlocking sets of thin plates, used in connection with the regular draft springs, and so receiving and absorbing the momentum due to shocks. In the test, 2 Penna. R. R. goudola cars were fitted with the friction buffers; on a piece of straight track the brakes of one car were firmly set and the other was shot against it by a locomotive. In 14 such collisions the speed was increased from 5 to 30 miles per hour. In the twelfth test, at a speed of 28 miles per hour, some of the blocking back of one of the buffers was smashed by the concussion, and one of the car trucks broke loose from its fastenings, and stripped the body bolster. This was due to the momentum of the heavy truck, and the sudden stoppage of the car body. On the fourteenth test, a speed of 30 miles per hour was reached, with the result that one center sill on the moving car was cracked near the body bolster, and both center sills of the fixed car were cracked at the same place; the drawhead of the fixed car was also broken in the shank; the bolsters under both cars were partially stripped from their positions. The buffers, however, remained intact and uninjured. The two cars were so badly used up as to be unfit for further service, while the buffers will be transferred to other cars and continued in service.

These buffers will, theoretically, take up a momentum 6½ times as great as can be absorbed by an ordinary draft rigging, when in perfect condition; but, in fact, owing to the average loose condition of the draft gear of most ordinary cars, these friction buffers will absorb and take up from 12 to 15 times the momentum which ordinary draft rigging will take care of. The Union Switch & Signal Co. has made preparations to manufacture these friction buffers in large quantities, to meet the expected demand for them.

A NOVELTY IN CANAL CONSTRUCTION.—A new system of canal construction, says the *Coal Trades Review*, has been designed and recently patented by Mr. ARTHUR PICKARD, of the firm of Pickard Brothers, Leeds, and the inventor has just completed a working model which shows at a glance the leading principle of the invention, and the method by which it is carried into effect. The object is to do away entirely with the necessity for steam or horse power in canal traffic, and this end is sought to be attained by the creation of a current of water strong enough to carry the boats along from point to point. Mr. PICKARD has designed a double canal, at one end of which is a screw, resembling the propeller of a steamship. This screw, which is worked by steam power, forces the current in one direction, and causes it to return in the parallel division of the canal, the direction of the current being reversible at will. By this arrangement all loss of water is obviated and the bed of the canal is kept clean. The current is of course confined to each separate level of canal, and when locks intervene another current has to be created. In this case the two currents are worked by the same set of machinery.

The inventor contemplates the erection of tank canals, which could be erected on the surface of the ground, without excavating, in level country, and carried over valleys on lattice girder bridges. In order to adapt existing canals to the new method it would be necessary to divide them down the middle by means of a double row of piles driven into the ground, the space between the two rows being filled with clay. The boats, which are fitted with wheels, can be taken from the canal and run along a tramway to receive their cargoes at a pit bank or any other place not immediately adjacent to the water-side. It is proposed that the boats should be of smaller size than those now used, and that they should be built to offer as great a resistance to the water as possible, in order that the current may have full effect in their propulsion.

THE PROPOSED BOAT RAILWAY around the Dalles of the Columbia river has been reported on by a board of engineers appointed by the Secretary of War. They estimate the cost at $431,500 and the time required for construction at one year. The present report is a preliminary one, and in the final report they will discuss the proposal to use hydraulic lifts instead of locks or inclined planes for raising the boats.

THE GRAND BRIDGE CO. is the name of a corporation now asking privileges from the New York Legislature; and the purpose is to build and maintain a bridge over the East River. The capital stock is to be $10,000,000. The locators named in the bill are A. H. DAILEY, a Brooklyn lawyer, CHARLES SOOYSMITH, of the firm of Wm. Sooy Smith & Son and MICHAEL O'KEEFF. The bill would permit the company to consolidate with any other bridge company, and it may lease its bridge to any chartered corporation of the State of New York. In other words, it would not be a public highway, in the sense that its control would not rest with the authorities of the two cities.

ENGINEERING NEWS
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EDITORS.
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Drawings for publication *should preferably be in plain black and white, considerably larger than they are expected to appear, with letters and figures in pencil only, all lines clean and bold.*

Coming Technical Meetings.

Engineers' Club, Philadelphia, Pa.—Regular meeting, Feb. 2. Secy. Howard Murphy, 1122 Girard St.

Engineers' Club of Kansas City, Mo.—Regular meeting, Feb. 4. "The Details of Iron Highway Bridges," E. W. Stern. Secy., Kenneth Allen, Y.M.C.A. Building.

Western Society of Engineers, Chicago, Ill.—Regular meeting, Feb. 6. Secy., John W. Weston, Gaff Building.

American Society of Civil Engineers, New York.—Regular meeting, Feb. 6. Secy., John Bogart, 127 E. 23d St.

Engineers' Club of St. Louis, Mo.—Regular meeting Feb. 6. "Rainfall and River Discharge in the Mississippi Valley", Prof. F. E. Nipher; "Adding Machines", N. W. Perkins, Jr. Secy., Wm. H. Bryan, 709 Market St.

Civil Engineers' Club of Cleveland, O.—Regular meeting, Feb. 12. Report on Applied Science. Secy., James Ritchie, Case Library Rooms.

New England Railway Club, Boston, Mass.—Regular meeting, Feb. 13. Boston & Albany passenger station.

Engineers' Society of Western Pennsylvania, Pittsburg, Pa.—Regular meeting, Feb. 19. Secy., S. M. Wickersham, Penn Bldg.

American Institute of Mining Engineers.—The 33d meeting will be held at New York, on Feb. 19. Secy., R. W. Raymond, 13 Burling Slip, New York.

Boston Society of Civil Engineers, Boston, Mass.—Regular meeting, Feb. 20. Secy., S. E. Tinkham, City Hall.

New York Railway Club.—Next meeting Feb. 21. Rooms, 113 Liberty St., New York City.

IN its issue of Jan. 11, the *Railway Age*, of Chicago, devoted over two columns of its valuable space to an attack upon the statistics of railway construction during the year 1888 which were published in this journal, and a defence of its own statements. We presume this attack upon the accuracy of our record is due to the fact that in our issue of Jan. 5 we called attention to the discrepancy between its statement and our own, and suggested to our contemporary that it was spreading reports needlessly inaccurate by its want of care in excluding from its list lines not properly to be included as main track mileage. The *Age* answers this criticism by saying that in making up its records it has conscientiously intended to report only main line track actually laid down during the year, "avoiding the temptation to swell the statement by mileage laid in the previous year by logging roads of a temporary character, or by street railways."

In a short table of lines which it says were not included in our record, we look with interest to see how successful has been its effort to resist the above mentioned temptation. We find 27 lines aggregating 208 miles, which to the best of our knowledge and belief, based in most cases on official reports, are intended for the transportation of either passengers or freight alone, and should therefore not be included. We find about 60 miles, which, according to official reports to this office, were laid in 1887. We find 78 miles on 9 different lines where by official report to us no track has been laid. Of the remainder, about 140 miles have not been reported to this office as complete, and from all the data at hand we were led to exclude them from our list given in the issue of Dec. 29, while 137 miles we find to be legitimate corrections, most of which have been already reported to this office since the begining of the year. On the other hand a considerable mileage of lines included in our record and not included by the *Age*, is judiciously passed over by that journal, which has the advantage of us in this respect, that we published a complete list of all the lines covered by our record, while the *Age* did not do this, but simply published totals, so that the only check we have upon that record is when the aggregate of certain States is less than our own, as it was in several instances, and then we cannot specify the specific omissions which caused the discrepancy.

The most important point at issue, which the *Age* judiciously passes by, is whether in making up either of the two summaries, proper care was taken to exclude all tracklaying which should not be included as part of the general railway system. Did our contemporary, in sending out requests for information regarding the year's construction, distinctly specify that lumber, mining and street roads not intended to do business as common carriers of both freight and passenger traffic, were not to be included as new construction?

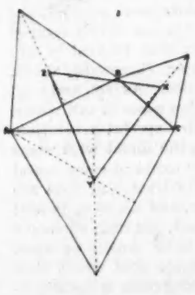
According to reliable information we think that it did not. The *Age* is an excellent journal and has done some useful work in collecting statistics; but unless and until it collects this information on a proper basis, it must be prepared to have exceptions taken.

THE interest in the improvement of county roads is spreading, if we can judge from our exchanges; and as agitation in the local press is the first step towards better methods, the present sign is encouraging. But while these papers unite in deploring the existing condition of the only means of communication many sections of our country yet have, no real improvement can be hoped for until the lawmakers of each State unite with experienced engineers and together formulate a law that will compel a change. We all know the roads are bad; what is wanted is the most feasible method of making them better, and the means of totally abolishing the present slip-shod system of not-doing-it. The opposition to improvement assessments will come from the parties who will in the end be most benefited, that is the farmers; and any new laws must be carefully framed so as to be both just and firm with this element of our population. First of all, law is wanted to properly apportion the cost of new work, enforce a well digested system of highways and provide for the faithful execution of plans; with this power in hand, we have engineers now who are fully capable of directing the work, and would soon have more as the demand grows. But the Legislative bodies must take the first step.

THE trial of the 15-in. pneumatic gun at Fort Hamilton last Saturday, while not a total success, showed that a projectile charged with 300 lbs. of explosive gelatine and 200 lbs. of dynamite could be safely discharged by the use of compressed air. Until this trial, 100 lbs. of explosive had been the maximum discharged from a pneumatic gun, and this advance to 500 lbs. is a most decided one. It is now shown that a large charge can be handled as safely as the smaller one in this gun, and as a weapon of offense it is just so much more powerful; in fact, it would now seem that it is a question of propelling power only that limits the size of the projectile and the weight of its destructive charge. In the late experiment the first shot with the 15-in. gun, intended for the armament of the new *Vesuvius*, overshot the contract range of 1 mile by nearly 15 per cent. A leakage in the air-valve and the breaking of one of the guiding vanes on the projectile made the second shot a failure in range and directness of flight; but the explosion was perfect, showing that the fault was with details only, that can easily be corrected. The contract also called for one shot every two minutes; and while the accident prevented this part of the test from being carried out, this rapidity of fire has been attained in the 8-in. gun, and there is no reasonable doubt but that the 15-in. gun will do as well. While the maximum range of the pneumatic gun will hardly exceed 1½ miles, as compared with the 4-mile range of modern naval ordnance, it will make the entrance to a harbor protected by these dynamite-throwers a rather desperate undertaking. It yet remains to be seen how its accuracy of fire will be effected when this gun is mounted on a fast-going vessel like the *Vesuvius*. If this trial, yet to take place, proves satisfactory, our Government may again and with confidence look forward to upsetting generally received ideas of naval warfare, on the coast at least. The Americans introduced iron-clads in 1860; and 30 years later we may render anything but the cruising type a very expensive luxury.

THE "simple nut to crack" contributed to our issue of Jan. 5, has had the usual effect of such simple nuts to bring in a flood of communications and general discussions, some of them quite interesting and meritorious. But the problem is of too simple and elementary a nature to make it seem proper to give space to the discussions. As there are a good many, however, who like the exercise of cracking such nuts, we will give them one in the following figure which they will not find quite so simple, and which we do not think will lead to our being overburdened with answers.

Take any triangle, $A\,B\,C$, scalene or otherwise; erect on each of its sides an equilateral triangle; determine the centers of gravity, of each of these triangles; construct the triangle $X\,Y\,Z$; prove by geometry that it is an equilateral triangle, as in every case it will be; and prove also that the centers of gravity of the triangle $A\,B\,C$ and of the triangle $X\,Y\,Z$ are one and the same point.



The proof of the first part of the problem may of course be either that any two sides are equal or that any two angles are equal, or that each single angle is 60°; and we have been told that there are neat geometric proofs of each of these facts, (as of course there should be) although we have only seen one of them. We presume, likewise, although we have not tried it, that it can be demonstrated by analytical geometry

more simply than by plain geometry; but that is not the problem, although we shall be pleased to publish such a demonstration likewise, if sent to us. We shall wait for two or three issues before publishing any answers to this problem, in order to give every one who chooses a chance to try at it. It will not be found so easy as the *pons asinorum*.

Now that the contested election of the American Society of Civil Engineers is happily over, with no bones broken, we hope it will not be forgotten that by general agreement of both sides to that contest, there are certain highly objectionable elements in the present system of nominating and electing officers in that Society, and that a more seemly way of regularly providing for a real expression of the views of the membership, without any appearance of reflection upon individuals, is highly desirable. As showing how this thing is done in the oldest and greatest of all engineering societies we reproduce below the last ballot list of the Institution of Civil Engineers.

THE INSTITUTION OF CIVIL ENGINEERS.
BALLOTING LIST. TUESDAY EVENING, May 29, 1888, at 8 o'clock.

TO BE PRESENTED PERSONALLY.

By Sect. II., Cl. 8, of the By-Laws, "The Officers of the Institution shall be a President, Four Vice-Presidents, and Fifteen other Members of Council, being Twenty persons."

PRESIDENT.

Bruce, *George Barclay,*

VICE-PRESIDENTS.

The votes for any members who may not be elected as vice-presidents will count for them as Other Members of Council.

Coode, Sir *John*, K. C. M. G
Berkley, *George*
Hayter, *Harrison*
Giles, *Alfred*, M. P

OTHER MEMBERS OF COUNCIL.

Anderson, *William*
Baker, *Benjamin*
Barry, *John Wolfe*
Bessemer, Sir *Henry*, F. R. S.
Brown, Thomas Forster.
Cowper, *Edward Alfred*
Cunningham, George Miller, F. R. S. E.
Douglass, Sir *James Nicholas*, F. R. S.
Forster, George Baker, M. A.
Fox, Sir *Douglas*
Hawksley, *Charles*
Lewis, William Bourne.
Lyster, George Fosbery.
Mansergh, *James*
Preece, *William Henry*, F. R. S.
Rawlinson. Sir *Robert*, K. C. B.
Reed, Sir *Edward James*, K. C. B., F. R. S., M. P.
Shelford, *William*
Stileman, *Francis Croughton*
Stoney, Bindon Blood, L. L. D., F. R. S.
Thomson, Sir *William*, D. C. L., F. R. SS. L. & E.
Thornycroft, John Isaac.
Webb, Francis William
Westmacott, Percy G. B.

Any list presented with a GREATER NUMBER or with a LESS NUMBER than one president, four vice-presidents, and fifteen members, will be rejected by the scrutineers as informal, and the votes will consequently be lost.

To illustrate the practice of the Institution we have printed *in italics* those who held the offices for which they were renominated on Aug. 3, 1887.

THIS list contains 29 names, from which 9 names are to be struck. Hardly any two ballots will have the same names struck off; but as nearly one-third of the whole are so struck off, the list provides real opportunity for an effectual expression of each voter's opinion, and the 9 men who have the lowest vote are simply not elected. The unwritten law of the Institution appears to be that all members of the Council shall be renominated *ex officio*; at least, it was so on this ballot, and thus the very desirable end of retaining efficient and desirable officers, while yet affording free expression to the popular will, is attained.

It does not appear clear that the system of the Institution is in all respects what might be desired. For instance, there are no additional names printed for the office of Vice-President, nor for that of President and even for the nominee for that office there is no choice, the by-laws providing that the senior Vice-Presidents in rotation shall be the nominee. Neither does it appear altogether proper that the Council should do all the nominating for office. At least, that would hardly accord with our American ideas; but the substance of the system is admirable, and the body chosen is necessarily a really representative one, and large enough to fully represent the society, which is not the case in the American Society, its governing body consisting of only 10 members instead of 20, 4 of whom are usually non-residents who attend few meetings, and 2 of whom are the Secretary and Treasurer, who are necessarily permanent executive officers, who are not admitted at all to the Council of the Institution, but who practically control the Board of Direction of the Am. Soc. C E. No harm has resulted so far from this anomalous condition of things, or perhaps, it may even be, much good, but it is obvious that as a permanent system it is entirely improper. The Institution has no system of letter ballot, so that only members present at the meetings can vote, and in that respect also its system would be unsuited for us; but there is no reason why the same forms of ballots should not be used for letter ballot elections; and we may add, there is no apparent reason why the voter who is entitled to cast 15 votes for directors should not divide his 15 votes as he pleases among one, two or a dozen candidates, instead of casting one each for 15 men, should he so elect. This provides for a still freer and fuller expression of the will of the membership, and that is what should be sought.

THE snow and sleet of last Sunday broke a number of the overhead wires in this city and they brought down in a number of cases the electric light wires along with them. A loop of ordinary telegraph wire on the ground or near it is a dangerous nuisance; but the severed end of an electric light wire means death to anyone coming in contact with it. In fact a horse was killed by such a wire on Monday morning, while watering in front of 361 West St., and its owner would probably have shared its fate, had it not been for the timely warning of a patrolman. As a snowstorm is liable to break down these wires at any time in the winter months, and other accidents may bring about like results in summer, public safety as well as a proper regard for the appearance of our city demand the removal of these overhead wires. We have miles of conduit now built, and if the reports as to the worthless character of some, at least, of these are well founded, the fact cannot be found out too soon. Underground conduits do work in other cities and there is no reason why they should not be as well designed and well built in New York. It is true that the purchase of cables and the transfer of wires will cost the telegraph and electric light companies money; but the law calling for the burial of wires, if it means anything, means that this money shall be spent.

THE Railway Commission of Iowa has won a victory in its fight for a reduction of railway rates to conform to the tariff adopted by the Commission.

In a lengthy opinion, Judge BREWER of the United States Circuit Court has decided that the Iowa railway law is a criminal statute, and that cases arising under it cannot be removed to the United States courts. The importance of this decision is manifest. The railway companies, which have refused to follow the tariff rates laid down by the Commission, have no appeal from the State Courts, and fines for non-compliance with the tariff may now be heaped on them without mercy.

Judge BREWER concludes his opinion by saying that he has been forced to this conclusion against his first impressions and appreciates fully the difficult position in which the decision places the railway companies. "But nothwithstanding these difficulties, back of all the statutes and all the litigation in the State stands that high tribunal, the Federal Supreme Court, which will ultimately determine and fully protect all rights guaranteed by the Federal Constitution."

To what lengths the Iowa State authorities will go in enforcing their law, remains to be seen. If they meet the expectations of some of the most rabid of the anti-railway agitators, the owners of Iowa railways may certainly bring suit in the United States courts to recover the value of their confiscated property. The State may exercise its rights to regulate the receipts and expenditures of the railway companies, but in so doing it becomes responsible to the owners of the roads for any injury which may thus be done to their property rights.

The American and British Commercial Marine.

The remarkable character of the performance noted last week of the new dynamite cruiser *Vesuvius*, in making 21.646 knots or 24.915 miles per hour on a measured course of 5.086 knots, without loss of steam pressure, is a gratifying evidence that our hand has not yet lost its cunning in designing ocean vessels, and has suggested to us, to make a brief retrospect of the past and guess at the probable future of our maratime status.

The remarkable nature of the *Vesuvius* performance will be best appreciated by comparing it with the performance of the "greyhounds of the Atlantic." These have all been outdone last week by the *Umbria* which made the voyage from Sandy Hook to Fastnet light, about 2750 knots, in 6 days, 2 h. 45 m., beating all previous records by 23 minutes. This is at the rate of about 18.7 knots per hour, and the number of war ships is still small which can do better than that at their best. At the *Vesuvius* test speed the same voyage would be made in about 127 hours, or 5 days, 7 hours. But a still more remarkable fact is that this was done with the machinery as first designed without a single change or break-down, whereas most of the foreign fast performances have been only after repeated slight changes in the screw and machinery. Thus the *Reina Regente*, the next fastest man-of-war, made its 20.6 knots only on the seventh trial. It is reasonable to suppose that by a second trial with the *Vesuvius* or other vessel, still better records than this first one may be made here also; but even if not, it is likely to be some time before the record is surpassed. It is not only gratifying, but we cannot but feel astounding, that our few and comparatively unpracticed designers should be able to so quickly outdo the hundreds of English designers who have been practising for a quarter of a century on thousands of vessels, not only for their own navy but for that of almost every other civilized nation except our own. It goes far to justify the confidence that Americans have always felt, that the best iron ships would be built here whenever commercial conditions changed so as to permit us to again become a sea-going people, as the best wooden ships had been for half a century before 1860; and it appears as if the day was now not far off when we are likely to again become an active competitor on the ocean for the commerce of the world.

Too much importance has been assigned to the *Alabama* and her sister ships as a cause for our sad decrease in sea-going activity since

1861. The *Alabama* only hastened by a few years a change which we may hope is but temporary, but which at any rate was inevitable from two great causes: the change from wooden to iron ships and the expanding opportunity for more profitable investment of both capital and energy in the internal development of our own continent. Wooden ships could be built somewhat cheaper in America than England for over a century. It is denied on grounds that seem plausible that even wooden ships were ever as cheap here as in England; but on the whole, it seems to us, the average was in our favor, by a small percentage. It only needed that they should be likewise designed a little better to give Americans a decided advantage on the sea; and such an advantage they for a long time had. American ships, as a rule, could obtain decidedly higher freight rates than English throughout the world until about 1860. In the China and East India trade, American ships were often able to get more than double the rates of English ships. But about 1860 came simultaneously the advent of the iron ship and the introduction of transcontinental railways carrying at cheap rates. The war came, too; but apart from that, "Go west, young man," became the motto of whole towns whose entire male population had for generations before followed the sea, and with the most brilliant success. Both the men who built and the men who sailed these ships found a better and more paying field for their labor and money in interior development, besides which was an absolute necessity that when iron ships took the place of wood, our naval progress should be checked until we caught up with England as an iron working nation. This could not in the nature of things be very soon. Given two great branches of the same race, one of which had no possible scope for its energies except on the sea and in the countries beyond it, while the other had vast possibilities suddenly opened in an almost boundless interior, and the result could not have been different from what it was, nor is it likely that the change back again, when it comes, will be a very abrupt one; for it will mark the dawn of a sorry day for English commerce when this country, in addition to keeping all the vast wealth and commerce which it has created within itself, finds itself likewise able to divert enough surplus men and money from other fields to compete with England on equal terms upon the sea, and again takes the world for its oyster instead of one continent only. It needs no prophet to foretell the result; but only a dispassionate investigator who will duly weigh the records of the past. The most salient features of this record may be compressed into this brief table:

Thousands of tons Shipping.

	British Amt.	Incr.	American Amt.	Incr.	P. c. Am. to Br.
1800	1,856	— —	972	— —	52.3
1810	2,426	570	1,425	453	58.8
1820	2,654	228	1,280	— 175	48.3
1830	2,533	— 121	1,192	— 88	47.0
1840	3,311	778	2,181	989	66.0
1850	4,233	922	3,535	1,354	83.6
1860	5,713	1,480	5,354	1,819	93.7
1880	8,535	2,822	4,058		47.5

On June 30, 1861, our total tonnage was 5,540 tons or 97 per cent. of that of Great Britain. It is claimed that at its very maximum it slightly exceeded that of great Britain for a few weeks, but we have not the figures at hand on which this claim is made. The "British" total, moreover, includes colonial, throughout this table, and in 1881 the comparative colonial and British tonnage proper stood as follows:

	Thousands of tons.	Per cent.
United Kingdom proper	6,692	78.4
Canada	1,311	15.3
Australia	278	3.3
Other British colonies	254	3.0
Total, as above	8,535	100.0
U. S. tonnage including steamboats	4,058	

The increase from 1881 to 1886 has been:

	Thousands of tons 1881	1886	Incr.	Incr. p.c.
Great Britain proper	6,692	7,371	629	9.4
Colonies	1,843	1,924	81	4.4
United States	4,058	4,131	73	1.8
Steam Vessels only.				
British	3,004	3,962	958	31.7
American	1,211	1,523	312	25.9

In 1887 the American steam tonnage was 1,543 thousand tons, but the total tonnage had decreased to 4,106 thousand. About 35,000 tons per annum has been the average iron shipbuilding output of the United States for 6 or 8 years past. The English output is now about 10 times as much, and in the "boom" year of 1882 was about 20 times as much.

The last figures have a discouraging look, especially if one does not realize what the United States has been doing in other directions in the meantime, but on the whole, it will be seen that there is no such enormous difference between the shipping interest of Great Britain proper and the United States as is commonly supposed, even to-day. For it is hardly proper, in the first place, to include the colonies unqualifiedly with Great Britain in such a matter. They are only in a political sense a part of the English empire. Commercially they are as much independent nations as we are. Their shipping is owned at home; its profits stay at home; and tariffs exist against Great Britain as high as against the United States. The first outbreak of any serious maritime war would probably drive Canada at least into independence. On the other hand the great American steamboat interest, to which there is no real British parallel, is included above as a part of our shipbuilding activity. It is not ocean trade, but it contributes an important part to that nucleus of plant and experience from which will come in time a revival of American ship-building on a large scale, and hence ought properly to be included. Our shipping in foreign trade, however, only aggregated, in 1887, 980,412 tons, having come down to six digits for the first time since 1846. Its maximum was in 1861, 2,497,894 on s in a total of 5,539,813 tons, 3,041,919 tons being coastwise, and whale and cod fisheries. In 1881 we had fallen to 4,058,000 tons against 7,321,000 British, or to 55½ per cent. In the next 5 years, while our total tonnage has increased but little, we have kept up better than would be supposed in our steamship interest, and have now 38½ per cent. as much steam tonnage afloat as Great Britain.

In view of what we did accomplish between 1830 and 1860, how long ought it to take us to recover all our lost ground once more if conditions once change so as to cause a beginning in earnest? It will be seen from the first table above, that our shipping remained nearly constant at 50 per cent. of the British, neither increasing much, from 1810 to 1831. Between 1820 and 1830 both British and American shipping fell off heavily, but our own most. In 1830 a sharp increase began in both countries and in 30 years we increased our tonnage nearly 450 per cent. against 226 per cent. British increase; giving us 94 per cent. of the British tonnage, or just double the 47 per cent. with which we started.

This was the achievement of a people of less than two-thirds the population and one-third the wealth of Great Britain, and burdened with something like 10 per cent. interest on capital instead of 4 or 5 per cent. We have now, or shall have by 1890, nearly double the population and fully 50 per cent. more total wealth than Great Britain, if we may trust the following figures from MULHALL'S "Dictionary of Statistics," while capital is as cheap here as anywhere.

	1840 No.	Ratio.	1860 No.	Ratio.	1880 No.	Ratio.
Population (millions)						
Great Britain	26.54	100.	28.73	100.	34.65	100.
United States	17.07	64.1	31.44	109.	50.16	144.7
Wealth (billions)						
Great Britain	19.40	100.	27.00	100.	42.4	100.
United States	3.90	19.8	18.80	69.5	46.2	108.9

Surely if 17 million people could accomplish what they did "before the war," in 30 years 70 million sought to be able to do as much, if they would in a still shorter time, "make an effort," and we think there are just grounds for the claim which has been authoritatively advanced, that the real difficulty with American shipping is not the first cost of the ships, which are little it any dearer than equally good ships abroad, but the fact that they are taxed out of existence after they are built, by various National, State and harbor charges to which the American ship is subject and the British ship is not subject. We do not vouch for the literal truth of this claim, but there is at least a great deal of foundation for it, and so far, efforts to induce Congress to modify these burdens have been of no avail. The difference in wages paid, which has always been great, cannot be a deciding cause, as it never was before. The captains of the old American liners used to receive salaries of $4,000 to $6,000 per year, which was a much larger sum then than now, whereas the captains of the enormous great foreign steamers which are the modern Liverpool liners receive the liberal stipend of about $200 per month, for handling 20 to 30 times as much traffic in a year.

If we could stand the higher wages of old days, we could surely stand the wages of to-day, if that were all. The underlying difficulty is that the Americans, as a people, have been too busy with other matters to care much either about their navy or their mercantile marine. As respects the navy, this absurd indifference has already ceased; and perhaps our success in building a new navy, if we continue to have success, may create a renewed interest in our mercantile marine as well. Not only should our laws be made as favorable as possible to shipping, but the establishment of regular lines should be aided by reasonable subsidies. It should not be forgotten that, while there are many English lines which now enjoy no subsidy, there are few routes on which the pioneer lines were not aided by liberal subsidies in one form or another, and the policy of granting such assistance still continues, as instanced by the new line from Vancouver, B. C., to China and Japan. It is called compensation for carrying the mails, but it amounts to a great subsidy, which gives the line a heavy advantage over our lines from San Francisco, to which port the Vancouver steamers have to go to get the bulk of their cargoes.

CORRESPONDENCE.

Steel Chain Tapes.

PHILADELPHIA, Jan. 15, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

We notice in your issue of 12 inst., a communication from A. J. GRANT, C. E., Oakland, Fla., in reference to brass tapes, with your description and foot note of the same.

We send you by to-day's express, for your inspection one of our "chain-tapes" as described on page 69 of our catalogue. This tape in our opinion possesses many points of advantage over the brass tape, and none of its disadvantages, except it has more bulk.

The graduations are plainly marked, "chain-style" in feet, by riveting a small brass sleeve on the tape. The sleeve is easily replaced or the tape mended by the engineer, without the annoyance of sending it to outside parties. The tape can be dragged through water, brush, over stumps, etc., with very little danger of breaking and with little or no care will last a long time.

The steel wire that it is made from, you will n tice, is not the ordinary "hoop-skirt" wire, but is made specially for this tape, and made spring-temper, so that it will not

twist and kink, and when it is once given a fair trial it is seldom abandoned. It is the standard on many prominent railroads.

What Mr. GOERKE and Mr. DEITZ (in front of catalogue) say of it are only fair samples of many other letters received from customers who use them every day.

Yours Respectfully,
YOUNG & SONS.

[The "chain tape" referred to is an excellent instrument, and we have heard many people speak highly of it. Except for working in very rough country, it appears to us in every way preferable to a chain; but still, we cannot but believe that if the same ingenuity were devoted to perfecting a brass chain tape it would be preferable. An improvement to this tape for surveying work would be a "minus foot" at one end graduated to hundredths, as it is somewhat inconvenient to use a separate measure for that distance. The real scope of the instrument we take to be somewhat different from the brass tape, which was to cover the field of the graduated steel tape and steel chain tape in one and the same instrument. ED. ENG. NEWS.]

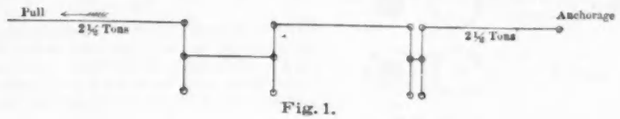


Fig. 1.

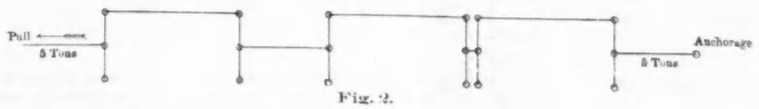


Fig. 2.

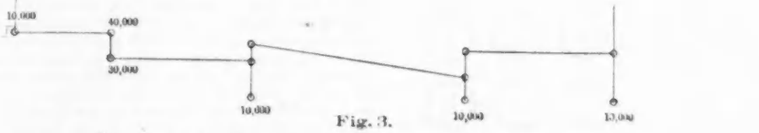


Fig. 3.

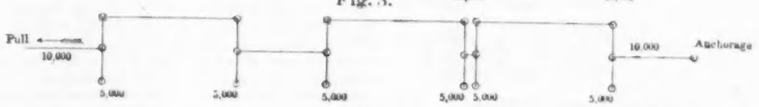


Fig. 4.

Locomotive Brake Gear Diagrams.

Locomotive Brake Gear.

ST. LOUIS, MO. Jan. 5, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

In an article read before the New York Railway Club Nov. 15, last, on "driver brakes," there are a great many things which show unfamiliarity with actual practice, and demand criticism. The author says that "a device to whose keeping human lives are entrusted cannot be pardoned for failure to do its whole duty, and no practical device can reach this high standard that uses a brake block on one side of a wheel only." If pains had been taken to investigate this matter a little more carefully, he would have ascertained that there are a large number of engine brakes with a block on one side of the wheel only, now in actual service, that reach this high standard, as will be illustrated further on.

"Simplicity and certainty are the two indispensable essentials in all practical railway work," is the stated language used. Now, if the device, with its 161 parts and 103 joints, which is illustrated by the author of the article referred to as being a perfect device, as applied to an 8-wheel connected engine, is what he calls "simplicity," then we are entirely in ignorance as to the meaning of that word. Regarding its "certainty," we will only quote an extract from the report of a prominent professor of mechanics on this device: "As a problem in statics, the number of wheels may be infinite. As a problem in kinematics, or in motion of parts, the limit is soon reached."

In order to obtain simplicity some sacrifice of theory has to be made in nearly all mechanical devices, and when this can be done without impairing the efficiency of the device, there is nothing lost; and this is one of the reasons why the one-shoe brake, with its 47 parts and 28 joints, was devised.

Regarding the idea of placing brake blocks upon the forward truck wheels, we suggest that while, of course, it is very desirable to apply braking pressure to every wheel on both engine and train, the ide of practicability must be taken into consideration, and as the proportion of weight on the forward truck of the engine to the entire train is so very small, the difference in distance where a stop is made with the forward trucks not equipped with a brake would be hardly perceptible, and the difficulties and dangers attendant upon applying a brake to the wheels of the forward truck are too manifest to admit of its adoption.

The article also states that 80 per cent. of the wheel weights has been adopted as their standard pressure. A large number of engines that have been equipped with 60 per cent. of the wheel weight for braking pressure, after being put in service, have had the percentage of braking pressure reduced even below that, as master mechanics and engineers complained that the power was too great, and after the change they gave perfect satisfaction. Under the most favorable circumstances, and while an engine is running at speed, there is no doubt 80 per cent. of the wheel weight can be used, but on switch engines, where the speed is generally very low, and in making stops with road engines, after the speed is under control, 80 per cent. of the weight for braking pressure has been found by actual practice to slide the wheels, causing a great deal of trouble and damage.

Fig. 1 is a diagram which corresponds to a similar diagram shown in the article, in which 2½ tons is exerted on one end of the system, ending with 2½ tons pressure on the other. This diagram does not correctly illustrate the principle of the squeeze brake, as one would infer that in order to obtain 2½ tons pressure on both sides of all the wheels only 2½ tons would have to be exerted on the first pull-rod with the same pressure on the anchorage at the other end of the system; whereas it would be, as shown in Fig. 2, with 5 tons pressure at each end of the system. He also says that "as we require to place 6 tons on each wheel in order to get our 60 tons pressure on the engine, it becomes evident that we can not obtain the maximum efficiency with a one shoe brake. No one would dare to put 6 tons pressure on one side only of the driving wheel." Let us take, for instance, an engine with 100,000 lbs. on drivers, and apply 60 per cent. of this weight for braking pressure, which, according to actual practice is all that it is safe to apply, and we show by the following result:

Fig. 3 shows the "one-shoe principle," as it is termed and Fig. 4 the "squeeze brake." In Fig. 3 we start with a pressure of 150 lbs. of steam, which gives us a pressure of 40,000 lbs. on fulcrum and 30,000 lbs. on first pull-rod, which, being equally distributed by this arrangement, gives 10,000 lbs. pressure on each wheel. Now, will any mechanic, who has the faintest idea of locomotive construction, says that this pressure dare not be put on the frame when the frame is so constructed as to carry 50,000 lbs., or the weight of one-half the boiler?

Again, this same engine, with a 20-in. cylinder, exerts 12,500 lbs. pressure (over 6 tons to each wheel) almost in a direct horizontal line, twice in each revolution, as shown in Fig. 5, and with the main brass only covering one-half of the journal, will any intelligent mechanic pretend to say that 5 tons pressure, as indicated by the arrow, Fig. 6, as exerted by the brake, will do as much harm as 6 tons pressure exerted by the cylinder, as indicated by the arrows in Fig. 5; and will not the wear on the brasses, if there are any, be as represented by the shaded lines; and will not the weight of the engine, where the brass is grooved out on the top, as it should be, cause wear enough on the top of the brass to assure nearly a perfect fit until it is worn out? If there were no weight on the main box, would not the power from the cylinder, exerted on the bearing, cause the box to jump off the journal? And would not the pressure exerted by the brake serve to keep the journal in the brass?

Fig. 7 shows the position of the levers of the squeeze brake, where ¾-in. slack is allowed to each shoe. This is not a large amount of slack to allow, as engine brakes can be seen all over the country at any time with from 1 in. to 1½ ins. slack. In this device the piston movement will be the sum of the movements of all the shoes, plus the sum total of all slack or lost motion in the joints, plus the total stretch in the rods, added to the sum of all the deflections in the levers. Allowing no slack at all in the 103 joints that are in this brake, we find that when the brake is off, the levers are in the position as shown at *A*, and when the brake is set it will be shown as at *B*; the last dotted lines, *C*, show the position where 1-32-in. of lost motion is allowed for each joint,

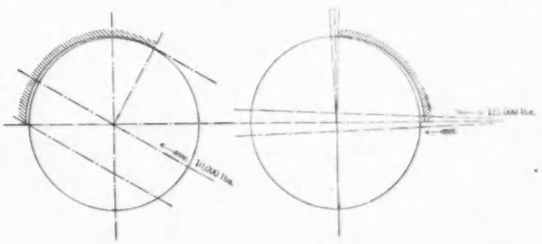


Fig. 6. Fig. 5.

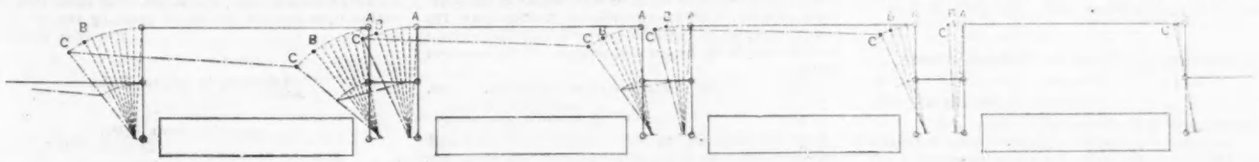


Fig. 7.

Locomotive Brake Gear Diagrams.

with only ½ in. added as the total spring of the 161 parts of which the brake is constructed, which is a very small amount. In fact, this low estimate of spring in the numerous parts, and lost motion in the 103 joints, as given above, would be at least doubled in actual practice; and for the reasons above stated, a brake of this design can not lay any very strong claims to practicability or simplicity. Let us suppose all of the parts to be in a worn condition, with 1 in. slack to each shoe, each joint ⅛ in. slack, ⅛ in. for each shoe for stretch and deflection of levers, there would be a movement of 2½ ins. of the first secondary rod for each shoe behind it. This would give a movement of 20 ins. for the driving wheels alone, to say nothing of extending the system to the forward trucks; and in order to get proper results the levers in the horizontal system should be at least three times as long as the longitudinal movement of one end, and hence, at the end next to the power these levers would need to be some 5 ft. in length. If these horizontal levers are not long enough to take up all of this longitudinal movement, then, when the brake is set, the shoes nearest the

power will bear more than 5,000 lbs., and this pressure will constantly diminish, and may become zero at the other end of the system.

Fig. 8 shows the "one-shoe brake", under the same conditions, and it will be seen that when the main pull-rod, *D*, moves any given distance, all of the levers, *E*, move exactly the same distance, so that if the main pull-rod move ¾ in., all of the floating levers move the same distance, and the spring of its 47 parts and lost motion in its 28 joints makes no material difference, but allows a very large amount of wear without any adjustment; while in the device, as shown in Fig. 7, it can be very plainly seen that unless it is kept very closely adjusted its efficiency will very soon be impaired or entirely destroyed.

A comparison of the number of parts used in the brake which the American Brake Company furnishes, with those contained in the brake (referred to in the paper, from which we quote above), may be shown as follows: [we omit the full list ED.]

Number of pieces on both sides of American brake for eight-wheel connected engine; 47 larger parts, 20 bolts, 28 pins, 95 total.

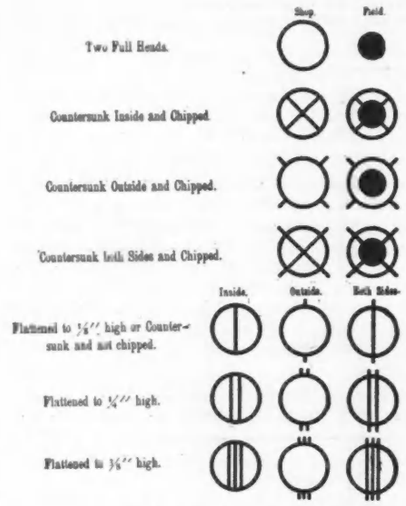
Number of pieces on both sides of a squeeze brake for eight-wheel connected engine; 161 larger parts, 20 bolts, 103 pins, 284 total.

This is one of those cases frequently met with where what seems upon its face to be quite a plausible theory does not prove to be practicable in meeting all the conditions of actual service. Very respectfully,

THE AMERICAN BRAKE CO.

By GEORGE H. POOR, Gen. Supt.

[The position stated as to not more than 60 per cent. of the insistent weight being an admissible brake pressure is undoubtedly correct; but we are disposed to dissent from the position that it is unimportant to brake the truck wheels, in fast passenger engines at least. The average passenger train weighs rather less than more than 200 tons, all told, and the average passenger truck now carries nearly



Conventional Code for Bridge Rivets.

or quite 13 tons, or say from 5 to 10 per cent. of the total weight. We may add also that there is no admissible gain in retarding effect from double brake-blocks, since the limit to it is fixed only by the retardation which will skid the wheels, which remains the same in either case. ED. ENG. NEWS.]

Conventional Code for Bridge Rivets.

PITTSBURG, Pa., Jan. 14, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

We enclose you a copy of a proposed code for bridge rivets which you will see has been quite generally adopted by the bridge companies throughout the country.

Besides the 24 leading bridge concerns and railways specified, the list should also contain the names of the New York Central Railway Co., the Smith Bridge Co., Toledo, O.; G. BOUSCAREN, Consulting Engineer, Cincinnati, O; MORISON & CORTHELL Consulting Engineers, New York and Chicago; JOHN W. BERRY, Bridge Builder, Pittston, Pa.; SAMUEL DIESCHER, Consulting Engineer, Pittsburg, Pa.; the New Jersey Steel & Iron Co., Trenton, N. J., and Levering & Garrigues, Bridge Builders, Philadelphia, Pa.

The idea in the above mentioned system has been to propose a system that would be of sufficient merit to meet the approval of all the bridge companies and to be adopted by them as a uniform standard. Heretofore the companies have had their own system, the railroad companies have had a system of their own, and different consulting engineers have had different systems. The result has been considerable confusion arising from interchange of drawings, and from bridge companies trying to work from drawings from railroad companies and from consulting engineers. The advantage of having a uniform system has been readily conceded by the bridge companies, as shown by the rapidity with which the above system has been adopted. However, the principal object in proposing the above, has been to secure uniformity. As to individual merit, the signs themselves we believe, have advantages over any system heretofore in use.

The diagonal cross which has been adopted for the representation of the countersink, shows by its position the location of the countersink, and in the same way the vertical strokes adopted for the flattened head rivets, indicate by their number and position, the height and location of the flattening. The worst possible case which would ever have to be indicated in the drawings would probably be a field rivet countersunk on one side by combining the proper sign of the system flattened on the other, but this is readily accomplished.

The foundation of the system is the diagonal cross to represent a countersink, the blackened circle for a field rivet, and the vertical stroke to indicate a flattened head. The position of the cross with respect to the circle (inside, outside or both sides) indicates the location of the countersink, and the number and position of the vertical strokes indicate the height and position of the flattened heads.

Hoping that the above may be of some interest, we are,

Yours very truly,

G. W. G. FERRIS & Co.

[The system seems to be excellently designed and ought certainly to become universal. We trust all our readers will note it and use it, unless there are objections which do not appear at first sight. ED. ENG. NEWS.]

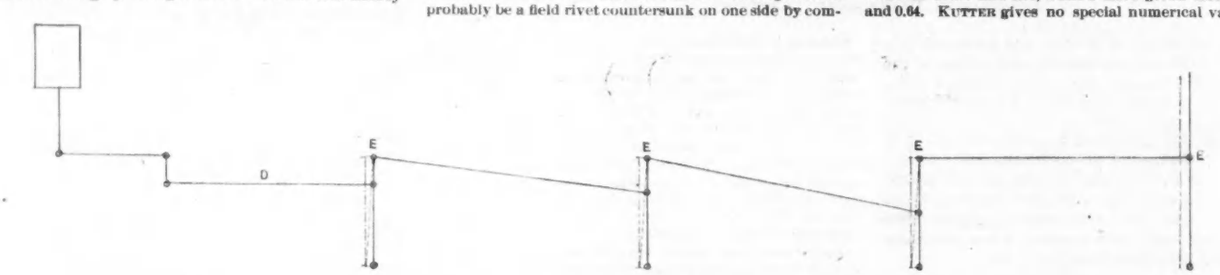


Fig. 8.

Locomotive Brake-Gear Diagram.

Velocity Formula for Sewers.

MEMPHIS, Tenn., Jan., 19, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

My attention has been called to "Formula for Velocity in Sewers" by RUDOLPH HERING, C. E., in your issue of Dec. 15, 1888.

If reference be had to page 220, Vol. 4, Journal of the Association of Engineering Societies" (1885) it will be seen that Mr. HERING has been anticipated.

Respectfully Yours,

R. F. HARTFORD.

NEW YORK, Jan. 23, 1889.

TO THE EDITOR OF ENGINEERING NEWS:

Mr. HARTFORD in the article above referred to claims to have given a "new sewer formula" and says, March 3, 1885, that he had previously used it "for several years."

It reads $$v = \frac{m R \sqrt{S}}{\sqrt{R} + n}$$

the algebraic form of which is precisely the same given by me in the paper reprinted by you Dec. 15, 1888, from the Proc. Engineers' Club of Phila. Vol. VII, No. 1, which formula I had used "since 1879" as stated.

In Feb. 1885, one month before Mr. HARTFORD's date, the same formula, algebraically expressed, was published by Mr. P. J. FLYNN in the Transactions of the Technical Society of the Pacific Coast. But already in 1878, 7 years earlier, Mr. CHAS. H. SWAN, then Assistant Engineer in the City Engineer's office, at Providence, R. I., had given the same as

$$v = \frac{z R \sqrt{S}}{\sqrt{R} + X}$$

in an introduction to some tables which were manifolded and circulated by the Department at the time. In fact Mr. KUTTER himself, in his work which came into my hands in 1876, gives his formula "when the influence of slope upon the co-efficient *c* is neglected," as

$$v = \frac{z}{1 + \frac{x}{\sqrt{R}}} \sqrt{R S} = \frac{z R \sqrt{S}}{\sqrt{R} + x}$$

Mr. HARTFORD therefore can claim no priority for his "new formula" as he had been anticipated by several engineers and in fact by KUTTER himself.

My object in sending the paper in question to the Engineers' Club of Philadelphia, was partly because a contribution was expected from me, and partly because the *numerical value* which I gave for the constants, had been tested for a long time, which I thought might interest some of the members. There was nothing to indicate that I claimed any "new formula for sewers" as did Mr. HARTFORD. He says that his abbreviated Kutter's formula is for falls *less* than 1 ft. in 2,000 ft., while my constants are for grades *steeper* than 1 : 2,500, which better covers the case of sewers. Mr. FLYNN and Mr. SWAN apply their abbreviations to slopes greater than 1 : 1,000.

The numerical values of the constants for average brickwork, are given by Mr. HARTFORD as 175.66 and 0.65 respectively, by Mr. FLYNN as 183.72 and 0.58, and by Mr. SWAN as 181.69 and 0.55, while I have given them as 188 and 0.64. KUTTER gives no special numerical values, as he was concerned only in a general formula applicable to rivers as well as to small channels.

While the above formulæ are therefore algebraically the same, the coefficients differ slightly. Those given by me for sewer purposes were intended to be simple, and always on the safe side. For all practical cases they are within 5 per cent. of the values given by the complete formula.

RUDOLPH HERING.

Adjustable Sight-Pole.

City Engineer's Office.

DULUTH, Jan. 1, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

The "Adjustable Engineers' Pole" described in your issue of Dec. 8 has suggested the idea of submitting to you a description and sketch of a pole that we have in daily use.

The most desirable pattern evidently is one that possesses stability against wind pressure, jarring from passing teams or other causes, accuracy, easy and quick manipulation, adaptation to any location including points on steep slopes, stone monuments, with or without iron frames, granite block pavement, telford, macadam packed gravel, solid rock, frozen ground, muck and points below water surface; advantages which we claim to have embodied in the pole herein described.

As will be seen by the accompanying sketch, the pole consists simply of an ordinary pin sight rod 7 ft. long, ¾ ins. thick, 3 and 2¾ ins. wide, fitted at the lower end with a steel point which is carefully lined with the target pointed the entire length of the rod. Near the middle is a hardwood block 4 ins. long, the broadest side fastened to the back of the pole by screws; the two opposite sides forming an angle of 120° and furnishing the bearing surfaces to which are bolted two of the extension legs of the tripod, while the other leg, which is also extensible, projects in the rear, and is pivoted in a slot at the lower end of the block. The extension legs each consist of two pieces of ¾ in. square oak, fitted with a steel point, two

guides and a clamp. Near the point is attached a strap and buckle, by which the legs are strapped to the pole when not in use. The pole complete weighs 8 lbs., although it might be made considerably lighter. It is very easily and quickly set by placing the rod directly on the "point", extending the legs, and clamping after plumbing, either with a plumb-bob held by hand or a spirit level permanently attached to the rod.

The apparatus proves very serviceable, saving one man to the party in triangulation work, or in running lines

Adjustable Sight-Pole.

requiring either front or backsights and in monument surveys requiring considerable accuracy.

A few other apparent advantages over Mr. ALBRIGHT'S pole might be discussed, space permitting, though evidently his pole has the advantage in regard to weight and cost, if such be considered an advantage. D. A. REED.

Graphic Traverse Tables.

NEW YORK, Jan. 16, 1889.

TO THE EDITOR OF ENGINEERING NEWS:—

Will you please publish in your paper an example of how the Graphic Traverse Table is used, and oblige

A SUBSCRIBER.

[We cannot well give an effective example without reproducing the diagram, but it is a very simple matter. In principle the diagram is ruled in squares, over which arcs are struck to represent distances from the origin in one corner, and radial lines are drawn to represent angles or bearings. Finding the point which represents a certain distance on a certain course, the latitudes and departures for it is at once read off within an error of possibly .001 more or less. The process is very simple, and within the limits of the error of observation, very accurate. ED. ENG. NEWS.]

The East Orange Sewerage Contract.

[Mr. B. J. COYLE, of Washington, D. C., the orgina! contractor for the above works, objects to the statement in our late article that he threw up the contract because "the material to be passed through proved exceptionally difficult." Mr. COYLE says that the courts will decide which party was to blame in the existing controversy. We are sorry if we have misrepresented the position of Mr. COYLE in this matter. But our representative in obtaining data for the article, necessarily used the material he could gather on the ground, without any intent of being one-sided in his treatment of the case. With Mr. COYLE we will leave the decision of this matter to the legal authorities who, we understand, are to sit in judgment upon it.—ED. ENG. NEWS.]

Notes, Queries and Answers.

E. D. B., in his query of Jan. 12, is referred to the Union Water Meter Co., of Worcester, Mass., who manufacture the reducing valve required. It is adapted especially to two systems of distribution, where a lower system is supplied by a high service main that is common to both; or to reduce the pressure in case of great unevenness of ground in the area supplied.

F. P. GUTELIUS, of Wellsville, Ohio, enquires for literature on the subject of interlocking switches. The best and most satisfactory literature on this subject is that issued by the makers of such switches, who will supply him on demand.

Mr. W. L. KILLEBREW, Civil Engineer, is wanted as to his present address by J. E. HAUDECKER, of Fort Worth' Texas. Mr. KILLEBREW was lately in Denison, Texas. The address is important to both parties.

Mr. C. H. WELLINGTON, West Upton, Mass., wants the address of parties manufacturing a portable derrick which can be applied to the stake-irons of a flat-car, to unload stone with.

C. S. C. writes: We have been using "Studley's Ballast, Tie and Rail Chart" on this road, but are not entirely satisfied with it, as we do not care to have the ballast and tie record kept with the rail record. Consequently the rail record can be gotten in a much more condensed form. Do you know of any other publication?

[We do not recall any such publication by name, although we have seen a number of them differing considerably in form, which may perhaps have covered requirements We shall be pleased to publish any forms that may have been found satisfactory.]

The name and address of the patentee of "The Jerrold Method of Setting Boiler Tubes" is wanted by the J. V. Carter Co., of Bordentown, N. J. A shop-right is sought for.

J. J. G., in our issue of Jan. 19, is answered by Mr. WM. GORE, of Cambridgeport, Mass., to the following effect: Mr. GORE, laid the Nickerson pavement in Boston, 35 years ago, on Mason St., and it lasted about 16 years with few repairs. The foundation was rolled smooth, with coal-tar on top; on the tar was laid a 1-in. board and on this 6-in. blocks with wooden strips between them $2 \times \frac{1}{2}$ in. The spaces between blocks, 4-ins. deep, were filled with dry roofing gravel and rammed with a suitable iron blade. Hot, boiling tar was then poured in between the blocks and covered with fine gravel. Mr. GORE thinks the pavement would have lasted longer if the boards had been tarred also and united with the blocks by coal-tar pitch. Dry-rot is the enemy of all such wooden pavements; but built as above, they will last 15 years under light travel.

The Argentine Republic.

At the present time, when the Argentine Republic is occupying so much attention in financial circles, the following particulars, given by the *Iron and Coal Trades Review*, as to the economic conditions of the Republic, may be of interest. The population 2 years ago was 3,093,670, and at the rate of immigration during the last 2 years it must at present be very nearly 3,500,000. The population of the city of Buenos Ayres is now very nearly 450,000, or some 100,000 more than that of the city of Mexico It is an interesting fact that the city of Buenos Ayres should contain an eighth part of the population of the entire Republic, and it is well in this connection to remember that the country is largely agricultural, and so fertile as to be able to support the activities of a large urban population of merchants, manufacturers, bankers, and officials.

The city of Mexico contains only a thirtieth part of the population of the nation of which it is the political and commercial capital. Were this country proportionately as well populated with active producers as is the Argentine Republic, one might reasonably expect to find 1,000,000 inhabitants in this, the chief city of the country, but, unfortunately, Mexico is apparently unable to attract immigration, a fact partly to be explained by the hostile attitude of a portion of the press to foreign immigration unless it be made up of colonists of Latin origin.

No such sentiment prevails in either the Argentine Republic or in Chili, countries where a provincial prejudice against foreigners no longer exists. Speaking of immigration, it is interesting to note that from 1871 to 1886 inclusive, there landed in the Argentine Republic 893,569 immigrants, while the emigration from the country during the same time was only 259,303. Of late, immigration has been increasing rapidly, and for the first nine months of 1888 the figures show an inflow of 105,255 colonists as against 77,519 arrived during the same period of 1887. The Buenos Ayres *Standard* estimates the total immigration for 1888 at 175,000. The same journal, which is noted for its general accuracy and lack of desire to exaggerate matters, says: "Next year, according to advices from Italy, a still greater hegira will take place from the Mediterranean, and what with the fortunes that Italian farmers will probably make this season out of wheat, and the misery in Europe, owing to the failure of the crops, it is not at all improbable that the immigrants that will flock to this country in 1889 will exceed 250,000 in numbers."

What immigration, welcomed, fostered, worked for, has done for the Republic is to be seen in the wonderful rise in the value of landed property there since 1882, when it was estimated by MULHALL at $527,000,000, and is set to-day by LATZINA at $800,000,000 gold, a rise of 50 per cent. In these figures the value of the national territories are not included. In these vast domains, we find a source of great wealth to the nation, for the 62,000 square leagues of national land are, at a moderate valuation, worth $186,000,000, gold. Here is the foundation of the national credit as it is taken into calculation by European capitalists and bankers. The area of cultivated land in the Republic is placed by Mr. LATZINA at 1,897,525 hectares, producing grain to the value of $85,293,185.

THE New York State Railway Commission's report for 1888, shows the following main results:

	1887	1888
Gross earnings	$143,724,491	$152,122,706
Operating expenses	92,439,971	101,605,082
Net earnings from operation	51,284,516	50,517,644
Income from other sources	5,543,671	5,732,752
Dividends declared	13,822,874.10	13,791,601.67
Surplus	8,284,403.60	5,362,292.58
Per cent. of gross income to cost	4.81	4.65
Per cent. of net income to capital stock	3.50	3.03
Per cent. of dividends to stock	2.19	2.18
Miles of road built	7,383.38	7,437.85
Million tons carried 1 mile	12,094	12,731
Increase in 1888		5.27 p. c.
Freight earnings per ton mile (cents)	.796	.797
Expenses	.514	.507
Profit	.282	.270
Million passengers carried 1 mile (exclusive of elevated roads)	2,010	2,199
Increase in 1888 of 9.4 per cent.		
Earnings per pass. mile, cts.	2.36	2.30
Expenses	1.51	1.57
Profit	.85	.73

The accidents were:

	Killed	Injured.
Passengers	17	161
Employés	210	934
Others	326	277
Total	553	1,372
Walking on track	337	232
Coupling cars	26	482

The Board objects to the exemption from the steam heating act of roads under 50 miles long and specifies by name the New York & New Haven as unduly backward. The Board will, we trust, make the legislature blush by its remark that the ten good bills (with one possible exception) which it had recommended, had been totally neglected by the latter body.

PERSONAL.

Mr. GEORGE E. EVANS was re-elected on Jan. 7 City Civil Engineer of Lowell, Mass.

Mr. R. L. VAN SANT has been appointed Chief Engineer of the Indianapolis, Decatur & Western.

Mr. CLEM HACKNEY, Superintendent of Motive Power of the Union Pacific, has resigned to accept a similar position on the Missouri Pacific.

Mr. JOHN BROOKS, Superintendent of Water-Works, Lansingburg, N. Y., has resigned his position.

Mr. J. N. FINNEY has been appointed Superintendent of Transportation of the Orange Belt road, with headquarters at Oakland, Fla.

Mr. A. J. PORTER, Superintendent of the Louisville Southern, has resigned, and will re-accept the position of Superintendent of the Kentucky & Indiana Bridge Co.

Mr. F. J. MCINTOSH, Civil Engineer, of Cicero, Ill., was killed recently by being run over by a Chicago & Northwestern train.

Mr. L. L. GERRY, C. E., formerly Superintendent of Water-Works, at North Attleboro, Mass., has opened an office at Dover, N. H.

Mr. P. O. LITTLEJOHN, the contractor who built the mountain division of the Baltimore & Ohio, died at Allegan, Mich., Jan. 15, at the age of 75.

Col. J. R. SHALER has been appointed General Manager of the Chattanooga, Rome & Columbus. A. MCCOLLISTER is Assistant General Manager.

Mr. THOMAS C. CLARKE, formerly with the Union Bridge Co., has been appointed President of the Cleveland, St. Louis & Kansas City road, vice J. T. K. HAYWARD.

Messrs. JOHN BOGART, E. D. T. MYERS, C. T. HARVEY, H. A. HITCHCOCK and A. M. WELLINGTON, have been appointed an Advisory Board of Engineers to examine and report upon the plans and estimates for the Nicaragua Canal.

Mr. J. R. ADAMS, Superintendent of Bridges & Buildings of the Atlantic system of the Southern Pacific, died at San Antonio, Tex., on Jan. 11. He had been with the road for nearly 20 years.

Mr. CALVIN TOMPKINS, Assoc. Am. Soc. C. E., is President of the Bonner Brick Company, incorporated at Albany on Jan. 2. The company owns 175 acres of land in Haverstraw Bay below Peekskill, and will at once erect a brick-making plant with a capacity of 10,000,000 per annum.

Mr. J. P. NELSON has been appointed Chief Engineer in charge of all Maintenance of Way matters of the Elizabeth, Lexington & Big Sandy division of the Newport News & Mississippi Valley system, with headquarters at Lexington, Ky.

Mr. STEPHEN B. ELKINS, of Philadelphia, has been elected 2nd Vice President of the St. Louis, Arkansas & Texas. Mr. HENRY F. HAARSTICK, of St. Louis, has been elected a director of the same road, vice H. G. ALLIS, of Little Rock, resigned.

Mr. T. W. RANSOM is appointed Master Mechanic of the Western Division of the New York, Lake Erie & Western, vice J. HAWTHORNE, resigned; headquarters at Hornellsville. JOSEPH H. MOORE is appointed Master Mechanic of the Delaware Division in place of T. W. RANSOM, transferred; headquarters at Port Jervis.

Mr. GEO. E. PRATT, who had charge of the construction of the Chautauqua Lake Railroad, and has been assistant to General Manager WILLIAMS of that company since, is now engaged with Thos. B. Inness & Co., railway contractors and dealers in railway equipment, with office at 115 Broadway, New York.

WM. MCRAE, of Lockport, N. Y., a well-known railway contractor and water-works builder, is stated to be financially embarrassed. The failure, however, is a personal one, and can easily be paid as the amount involved is only $50,000. The firm of Lally & McRae, of which he was a member, is in no way interested, and an assignee will be appointed to supervise his interest in the water-works of Dallas, Tex., Covington, Ky., and Emporia, Kan., now under construction, and also in certain railway contracts in Michigan.

Mr. A. MIDDLETON, formerly locating engineer on the Canadian Pacific Railway, has arrived at Ottawa, Ontario, from Brazil, whither he was sent by a syndicate of wealthy Canadian and American capitalists to report upon the feasibility of carrying out an extensive scheme for the development of the resources of a vast region in Dom Pedro's empire. The proposal is to establish lines of steamers on the Araguay river, and a railway to go around the rapids and unnavigable portion of the stream for a distance of 60 or 70 miles. The promoters propose to run their steamers as far as the Goyaz diamond mines, 1,600 miles from Para, on the Atlantic. Mr. MIDDLETON'S report will be submitted to a meeting of the promoters to be held in Montreal next week.

Mr. JAMES TILLINGHAST, assistant to the president of the New York Central since Mr. WM. H. VANDERBILT retired from the presidency, has resigned his position, and will be succeeded by Mr. HENRY WALTER WEBB, 1st Vice President of the Wagner Car Co. Mr. TILLINGHAST began his railroad career in July, 1850, as a fireman on the Utica & Schenectady, now a part of the New York Central. In 15 months he was made Master Mechanic and Assistant Superintendent of the Rome, Watertown & Ogdensburg, which position he held until April, 1856. At that time he became Superintendent of Motive Power and Assistant General Superintendent of the Toronto Northern, running from Toronto to Collingwood, Ont., where he remained until April 1, 1864. During the next year he was successively Master Mechanic of the western division of the Michigan Southern and Assistant Superintendent of the Buffalo & Erie, becoming Superintendent of the western division of the New York Central on Feb. 8, 1865. That position he held until Jan. 1, 1869, when he was made General Superintendent of the road. He filled that position until April, 1881, when he was made Assistant to the President of the New York Central.

PUBLICATIONS RECEIVED.

The Railroad as an Element in Education. Address before the International Congress of Educators, New Orleans Exposition. By Prof. ALEX. HOGG, M. A., Supt. Public Schools, Fort Worth.

Annual Report of the Chief of the Bureau of Steam Engineering, for the year 1888. GEO. W. MELVILLE, Chief Engr., U. S. N., Chief of Bureau. Pub. Doc., pp. 101; 9 plates.

This report is unusually full of technical matters of general interest, some of which we shall shortly reproduce, and the remainder summarize more fully in a later notice.

Tables for Laying Out Accurate Profiles of Gear Teeth. By Prof. J. F. KLEIN, Prof. Mech. Eng. Lehigh University Bethlehem, Pa. Large double-page card, 17 x 20 ins., $2.

This admirable publication we judge to be by long odds the most complete and convenient thing of the kind in existence, whether for the student, engineer or pattern maker. It gives the whole art in a nut-shell for all sizes and forms of teeth, enabling them to be laid out conveniently with considerably more accuracy than by ordinary methods. The sheet is a veritable MULTUM IN PARVO, and should be in the hands of every machinist and mechanical engineer.

The Economical Production of Charcoal for Blast Furnace Purposes. By OLIN H. LANDRETH, Vanderbilt University, Tenn. Reprint from the Proceedings of the American Association for the Advancement of Science. Salem, Mass. 1888.

Alfred Krupp: A sketch of his Life and Works, after the German of VICTOR NIEMEYER. By K. A. and O. E. MICHAELIS. To which is added a visit to the Krupp Works at Essen, from the French of Capt. E. MONTHAYE. New York, 1888, Thos. Prosser & Son, publishers; pp. 72.

Though our readers very generally are familiar with the work of this remarkable man, the story of his life as here simply told must add further respect for the name of ALFRED KRUPP, the creator of the unrivalled hive of industry described in the latter part of the same volume.

Whitaker's Almanac. 1889. London, 12 Warwick Lane, Paternoster Row.

The 704 pages of this "Englishman's Bible" show a material increase over any previous editions, and its table of contents cover so wide a field of useful knowledge, that its popularity is well deserved. It belongs to a class of works that make vain even a hint at its contents; but it is also one that every man, of every English speaking country, should have close to his elbow so that he may benefit by the vast fund of information concerning the world's doings and the affairs of men therein contained.

Krupp and De Bange: By E. MONTHAYE, Captain in the Belgian General Staff. Translated with an appendix by O. E. MICHAELIS, Ph. D., Captain of Ordnance, U. S. Army, M. Am. Soc. C. E., etc. New York, 1888, Thos. Prosser & Son, publisher, pp. 217.

The purpose of this work is to compare the ordnance systems of Krupp and De Bange, the two great European ordnance rivals, though differing intrinsically in material, construction and breech mechanism. The author first deals with the question of the best metal for heavy armament; and as compared with cast-iron, wrought-iron or even Uchatius bronze, he prefers steel as the typical gun-metal. In discussing the varieties of steel suitable for use, Bessemer steel is disposed of as too uncertain in its manufacture to be available; the Martin-Siemens process may be made to produce an excellent steel suitable for guns; only, however, on the condition that "a neutral atmosphere, a melting and a refining atmosphere, is attainable;" but crucible steel is noted as both theretically and practically the best for gun-making. The remainder of the work is devoted to a critical examination of the Krupp and De Bange systems of ordnance, and an investigation of the methods of manufacture as pursued at Essen and in France. The author decidedly favors the Krupp system and sets forth in full his reasons for so doing. An interesting description of the Krupp works, concludes the first part of this publication. The Appendix added is an analysis of criticisms made upon Capt. MONTHAYE'S book by French and English authors. This translation by Capt. MICHAELIS is the latest addition to our ordnance literature, and appearing at a time when the questions of practically creating heavy guns in our country is one of the vital questions of the day, it must be welcomed and valued.

SOCIETY PROCEEDINGS.

Engineers' Club of St. Louis.—The regular meeting was held Jan. 16, Mr. ROBT. MOORE in the chair, and 23 members and 3 visitors present. Mr. CARL GAYLER read a paper on "Wrought-Iron and Steel Eye-Bars," calling attention to the difference between European and American practice. He showed how, by the use of the testing machine, the form of the eye-bar had been greatly improved; described the standard forms in use, and their methods of construction, and showed that it was not safe to consider the strength of the complete eye-bar as great as that of the bar proper. Wrought-iron bars have had their day, and steel is now the metal almost universally employed. The two difficulties to be guarded against are overheating and an excess of phosphorus; the process of annealing was of benefit. The writer had recently tested 20 steel eye-bars, full size, and the results were surprisingly good. In the discussion it was stated that while the manufacturer might demand of the mills certain chemical proportions, the engineer need not do so, as he wanted only physical results. In piling the wrought-iron plates for making the head of the bars, care must be taken to place the plates so that the fibre is parallel to that of the bar itself. This fibre is always in the direction of the rolling.

The secretary read a paper by Prof. A. E. PHILLIPS, of Lafayette, Ind., on "A Burr Truss." The paper was descriptive of a bridge near Lafayette, Ind., and gave the results of an examination into its condition, which showed it to be dangerous. The author's conclusion was that it should be replaced by a safe and more substantial structure. In the discussion Mr. SMITH told of a similar bridge over Mill creek, Cincinnati, which had been used for many years, and was now in good condition. The arch was of beechwood, firmly built into the masonry. Mr. MOORE mentioned a wooden bridge, which to his knowledge had stood nearly 50 years. In his opinion the long life was due to the fact that the assumed load was never reached. Mr. GAYLER mentioned bridges in the old country over 100 years old. Parts showing the slightest deterioration were immediately replaced, by which method it was possible to maintain them indefinitely. Mr. HUBBARD spoke of the difficulty of calculating strains and Mr. SEDDON said that possibly the elasticity of wooden bridges permitted them to stand shocks better than iron. Prof. JOHNSON gave some of the characteristics of wooden members.

WM. H. BRYAN, *Secretary.*

Western Society of Engineers.—The annual meeting of this Chicago society was held Jan. 8; President GOTTLIEB in the chair, and about 40 members present. The following officers were elected: President, E. L. CORTHELL; Vice Presidents, CHAS. MACRITCHIE and SAMUEL MCELROY; Secretary, JOHN W. WESTON; Treasurer, H. W. PARKHURST; Librarian, G. A. M. LILJENCRANTZ; Trustee, CHAS. FITZSIMONS.

Engineers' Club of Kansas City.—In connection with the memorial and draft of an act to promote the safety of bridges, elsewhere noted in this issue, the Club has sent out a circular letter to the various engineering associations to the following purport:—It was first intended to provide for the appointment of a State Engineer of Bridges, but on discussion the danger of such office falling into politics and the direct expense to the State of such officer made this recommendation objectionable. In the proposed law the bridge experts receive their pay from the bridge owners; and to guard against the possible exercise of arbitrary power the law is framed so as to depend for its enforcement chiefly upon such enlightened public opinion as may be hereafter elicited. Lack of time prevented a submission of this draft of a law to the various societies before it was submitted to the Legislature.

KENNETH ALLEN, *Secretary.*

Civil Engineers' Club of Kansas.—The 12th regular meeting was held at Wichita, Kan., on Jan. 16. Mr. O. MULVEY read a paper on "Cements," and showed the results of a number of tests made at the office of the city engineer of Wichita during the construction of the sewers, etc. The regular meetings are held on the first Wednesday of each month, and the topic for discussion at the next meeting, Feb. 6, is "Highway Bridge Reform and the Legislation Needed." The officers for the current year are as follows: President, O. MULVEY; Vice-Presidents, W. R. KESLER, W. A. CRUSINBERRY; Secretary, J. C. HERRING; Treasurer, R. H. BROWN; Librarian, H. H. JACKMAN.

J. C. HERRING, *Secretary.*

Engineers' Club of Cincinnati.—The regular monthly meeting was held Jan. 2, with 28 members present. The Executive Board presented their annual report for the year ending Dec. 31, 1888.

Mr. WHINERY gave a description of the "Inclined Plane and the Broad Gauge Railway," recently built to the top of Lookout mountain at Chattanooga, Tenn. The Inclined Plane presents some peculiar and interesting features from the fact that a large portion of its length is on a curve. He also gave a short description of the railway built up Mission ridge in the same locality. This road, which is about 2¾ miles in length, has very heavy grades and curves, and requires an engine of special construction to operate it. This engine has 3 vertical cylinders, all on one side and engaging by gearing with a horizontal shaft, which in turn is connected by gearing with the drivers. Mr. WHINERY was connected with the location and construction of these roads.

J. F. WILSON, *Secretary.*

The R. P. I. Alumni Reunion will be held in Pittsburg, Pa., on Jan. 31 and Feb. 1, under the auspices of the Pittsburg Association of the R P.I. From advices already received, it is expected that this will be the most enthusiastic and generally enjoyable meeting of the alumni yet held. The programme published includes visits to fifteen or more points of engineering interest in and about Pittsburg as the guests of the resident members, and a banquet on Friday evening. Arrangements have been made with the Central Traffic Association, Trunk Line Association and Southern Passenger Association by which a ticket will entitle the bearer to return trip at one-third rate, beginning Jan. 28 and ending Feb. 4. Ten days ago 96 alumni had expressed their intention of being present. Any further information can be had from the Secretary of the Executive Committee, at Pittsburg.

Indiana Society of Civil Engineers and Surveyors:—At the annual meeting, held at Indianapolis recently the following officers were elected: President, J. C. PULSE, Greensburg; Vice-President, E. B. VAWTER, Lafayette; Recording Secretary, J. R. BROWN, Frankfort; Corresponding Secretary, G. M. CHENEY, Logansport; Treasurer, R. J. MORRISON, Knightstown.

Canadian Society of Civil Engineers.—The third annual meeting was held at Montreal Jan. 17. The annual report of the council was read by Prof. BOVEY, the Secretary, and showed that the Society has at present 542 members, with 16 more applications before the council at present; that up to date 68 members had identified themselves with the building fund, and that $3,281 had been promised for that purpose, of which $1,809.25 had been paid: and that there was a balance of $1,948.92 on hand including last year's balance of $960.92, the expenditure for the last year being $1,789.64, against an income of $2,777.-64. At the afternoon session an address was presented to the Governor-General. SAMUEL KEEFER is President of the Society.

The following is the Annual Report of the Secretary:

ROLL OF THE SOCIETY.

The Council notes with satisfaction that during the past year the membership of the Society has steadily increased. The elections comprise 28 Members, 19 Associate Members, 24 Associates, and 32 Students, while from various causes 19 have been removed from the list, the net increase for the year being 84.

The resignations were 1 Member and 1 Associate.

During the same period the Society has lost 1 member by death.

The total number on the list at the present date includes 2 Honorary Members, 259 Members, 87 Associate Members, 47 Associates, and 145 Students, or 565 in all.

Experience has made it evident that more attention should be given by members to the qualifications required for admission into the several classes, and it would much facilitate the work of the Council if a proposer would communicate to the Council, through the Secretary, his opinion as to the proper classification of a candidate.

It should also be borne in mind that in the case of Students, it is absolutely necessary that the candidate should produce satisfactory evidence of a general education, as required by By-Law 18, for the admission of Students who do not possess a proper degree of culture would lower the tone of the Society.

It is encouraging to find that eminent engineers, both in England and the United States, are enrolling themselves as members of our Society. It is a mark of its growing importance and surely a presage of its future success.

The Society is to be congratulated on the opening of the list of Honorary Members. The first name on the list is that of His Excellency, the Right-Honorable Lord STANLEY, of Preston, G. C. B., P. C., Governor General of the Dominion of Canada, etc., etc., who, eminent as a statesman, and fully recognizing the importance of great Public Works, has followed with deep interest the progress of engineering science.

The second name on the list is that of Sir WILLIAM DAWSON, L. L. D., F. R. S., K. C. M. G., Vice-Chancellor and Principal of McGill University, whose name would honor the roll of any scientific society, and who was the first to make a practical move in this country, in the direction of technical education, by the establishment at McGill College of a department of engineering, in the year 1856.

In connection with this, it is of interest to know that our *first* President was also the *first* Professor of Engineering.

There have been 16 ordinary meetings of the Society during the year 1888, at which the following papers have been read:

"The Telephone," by F. N. GISBORNE; "Six-foot Wooden Conduit for the Toronto Water-Works," by T. J. MCMINN; "Concrete as a Substitute for Masonry in Bridge Work," by M. MURPHY; "Railway Accidents and a Railway Commissior," by A. T. DRUMMOND; "The Canadian Pacific Ry. Bridges at Ste. Anne and Vaudreuil," by C. E. W. DODWELL; "Cedar Block Carriage-Ways," by A. MACDOUGALL; "Electric Lighting," by H. Y. THORNBERRY; "Masonry Arches for Railway Purposes," by W. B. DAWSON; "The Sewerage System of Vancouver," by E. MOHUN; "The Evolution of the Telegraph," by F. N. GISBORNE; "The Toronto Sewers," by C. H. RUST. "Coal Mining in Nova Scotia," by E. GILPIN, Jr.; "A Mine Pump Working under Heavy Pressure," by H. S. POOLE; "The Springhill Collieries," by R. W. LEONARD."

Particular mention might be made of Mr. GILPIN'S paper on "Coal Mining," which gives an exhaustive description of the present condition or the several collieries, and which will prove a valuable addition to the mining literature of the Dominion.

Under the auspices of the Society, a public lecture upon the "Electric Telegraph and other Electrical Inventions" was delivered by Mr. F. N. GISBORNE, Member of Council, upon Oct. 29. The lecture was one of much interest, and was listened to by a large and appreciative audience.

The Council hopes, from time to time, to make arrangements for similar lectures upon scientific subjects.

The discussions upon the different papers have been most animated, and have considerably enhanced their value. They might, however, with advantage, receive still greater attention, and the Council would especially urge non-resident members to show their interest in the Society by sending written criticisms of the several papers.

At the conclusion of the Annual Meeting, on Jan. 12, 1888, a conversazione was held at McGill College. An important feature of this entertainment was the delivery of the annual address by our past president, Mr. T. C. KEEFER. He most appropriately opened his address by a brief statement of the proceedings which had led to the formation of the Society, and continued with a most complete and valuable review of the important engineering works of the Dominion, severally treating them under the heads, "Railway, Hydraulic, Civic, Mechanical, Mining and Electrical Engineering."

There have been 3 Student's meetings, at which papers were read on the Montreal & Maskinonge Ry., by E. S. M. LOVELACE; on the "Water-supply of the city of Charlottetown, P. E. I.," by S. R. LEA; and on "Locomotive Construction," by J. P. TUPLIN.

Great care, thoughtfulness, and observation were shown in Mr. LEA'S paper, which the Council has deemed of sufficient merit to be published in the Transactions. The Council would impress on the students, the importance of making it a more regular practice to prepare papers, which will prove of no small advantage to themselves, and will fit them to become valuable members of the Society.

Since the last general meeting, a number of important donations to the Library have been received.

A complete list of members who have sent books, or money for the purchase of books, will be printed as soon as possible. In addition to the above, a number of valuable and interesting photographs have been presented to the Society. Rules for the Library and the catalogue are now in the printer's hands, and will be issued in a short time. From these rules it will be seen that arrangements are being made, by which members residing in the Dominion of Canada may borrow certain of the books from the Library. The Council would again remind all members of the obligations contracted by them at election to subscribe books, or their equivalent, to the Library. The proper equipment of this branch of the Society's work is most essential to its efficiency.

The Society continues to use rooms at McGILL University through the kindness of the Governors. Some progress has been made towards a fund for the erection of a building to meet the growing needs of the Society. The following statement will give the present condition of the Building Fund.

The Building Committee, appointed by the Council under the resolution passed at the last annual meeting, has during the present year issued two circulars, one on Feb. 11, and one on Oct. 1. Up to the present date, 36 members, 13 associates members, 2 associates, and 17 students have identified themselves with the fund, the total sum promised being $3,281, of which amount $1,809 have been paid to the Treasurer.

The Council has been especially gratified to observe the hearty response to the circular on the part of the Students. The Council, however, feels that this important question has not attracted the consideration it deserves, and hopes that within the next few months large additions may be made to the Fund.

The income for the year ended on Dec. 31, 1888, amounted to $2,777.64, and the general expenditure reached $1,789.64, leaving a balance of $988.00, which, together with the balance of $960.92, brought forward from the year 1887, gives a total balance of $1,948.92 to be carried forward.

ABSTRACT OF RECEIPTS AND EXPENDITURES FOR THE YEAR ENDING DEC. 31, 1888.

Balance from Dec. 31, 1887		$960.92
Dues		
Arrears	$ 56.00	
Current	1,983.00	
Advance	582.00	
Extra on local cheques	1.65	$2,622.65
From Building Fund for Stationery		9.00
Extra "Transactions" sold		97.00
Bank Interest		48.99
		3,738.56
BUILDING FUND.		
Subscriptions		1,262.40
Bank Interest		2.85
Total receipts		$5,003.81
EXPENDITURES.		
Transactions		757.40
Printing and Stationery		224.28
Postage, Messengers and Telegrams		269.68
Expenses of Secretary		350.50
Janitor's fee		15.00
Office Furniture and Books		133.35
Rent of Telephone		25.00
Bank commission on local cheques		3.65
Express charges on Books		10.78
Books, Printing and Stationery		15.55
Balance, General		1,948.92
Building Fund, in Bank		1,249.70
		$5,003.81

RAILWAYS.

EAST OF CHICAGO.—Existing Roads.

New York, New Haven & Hartford.—The Connecticut Board of Railroad Commissioners have made a report to the Legislature recommending that the company be authorized to increase its capital stock to the amount found necessary for the following purposes: (1.) To acquire the securities of the companies whose roads are under lease to the N. Y., N. H. & H. Co. for a longer period than 50 years. These securities amount at par value to about $18,000,000. (2.) To continue the quadruple tracking of the New York & New Haven division and to double track the Shore Line division at an estimated cost of $8,000,000. (3.) To eliminate existing grade crossings and improve the general character of the road and its equipment to meet the requirements of the service.

The Commissioners recommend further that the new stock shall not be issued to any person for less than par value; that present stockholders have the right to take their proportionate parts; that all shares not so taken be sold at auction on the New York Stock exchange for not less than par value; and that the total issue of new stock issued for improvements and additions shall not exceed the cost of such improvements as certified to by the President and Treasurer of the company and a civil engineer appointed by the Board of Railway Commissioners.

Housatonic.—An authorization of the proposed increase of stock by this company was also recommended by the Commission under the same restriction recommended for the preceding road. The increase, which it is estimated will reach at least $4,500,000, is for the purpose of building branches from Bridgeport east to connect with the New Haven & Derby road, and west to connect with the Danbury & Norwalk road, together with other branches whose location is not yet made public. It is also intended to double track the main line and the Danbury & Norwalk division and to improve the terminal facilities at various points.

Western New York & Pennsylvania.—At the annual meeting it was stated that this company now operates 844 miles of track and has an equipment of 120 locomotives, 114 passenger coaches and 6,520 freight cars. For the coming year it is planned to increase the capacity of the shops and grounds at Olean, to build a roundhouse at Emporium, and to repair and renew coal trestles at Buffalo. About 500,000 yds. of ballast are needed to put the road bed in proper condition.

Evansville & Richmond.—Columbus, Ind., has voted $75,000 to this company, and Jackson, Hamilton, Redding and Seymour townships have voted a two per cent. tax. The company has agreed to erect shops at Columbus.

Louisville, Evansville & St. Louis.—A recent report that this road had been sold to the MACKEY syndicate, controlling the Evansville & Terre Haute system, was quickly disproved.

New York, Ontario & Western.—Surveys are in progress for the extension from Hancock, N. Y., to the Lackawanna coal fields near Carbondale, Pa., about 31 miles.

Syracuse & Baldwinsville.—This New York company has defaulted on the interest payment due Jan. 1 and proceedings for foreclosure have been brought by the Central Trust Company of New York, the trustee of the bonds.

Baie des Chaleurs.—Track was laid on this road, in the northern part of the province of Quebec, from Nouvelle to Cascapedia, 20 miles, during 1888. The total trackage is now 60 miles. Work is to be resumed in the spring, and the line will be pushed on to Paspebiac as fast as possible.

Norwich & Worcester.—This company will petition the Connecticut Legislature for permission to extend its line from Norwich to Groton.

Philadelphia & Reading.—Some of the foreign holders of the third preference bonds of this company were dissatisfied because they received only 2½ per cent., for 1888, while the first and second preference bonds received 7½ per cent., and they cabled to President CORBIN that if they did not receive 7½ per cent. by February, they would begin legal proceedings. President CORBIN replied as follows:

"The State courts of Pennsylvania are open every day in the year. Their establishment has been for the adjustment of just such wrongs or rights as you claim to have. You know your redress, and if you have any complaint I advise you to make it."

——The 3 mile branch to Silverbrook, Pa., is to be built at once.

Cincinnati, Indianapolis, St. Louis & Chicago.—It is reported that President INGALLS intends to take up the scheme for a railway down the north bank of the Ohio river, from Lawrenceburg to Jeffersonville, Ind. The project was started two years ago, but only 4 miles were completed.

Ohio & Northwestern.—The Hillsboro branch has been changed to standard gauge.

Rome, Watertown & Ogdensburgh.—This company will double track its line from Rochester to Windsor Beach, about 6 miles, in the spring.

Buffalo, Rochester & Pittsburg.—The contract for shops for the Lincoln Park & Charlotte Ry., has been let to John Walters, of Machias, N. Y.

Hudson Connecting.—Right of way is all obtained for this road from Campbell Hall, N. Y., to the Poughkeepsie bridge, and grading and tracklaying are being rapidly pushed.

Canadian Pacific.—It is announced that the company has concluded arrangements with the Grand Trunk by which all freight from western Ontario to the Canadian Northwest will be forwarded over the Northern & North western division of the Grand Trunk *via* North Bay. Heretofore the C. P. R. has sent its freight a roundabout route *via* Smith's Falls to keep it on its own line. The agreement is important, as it indicates a movement toward harmonious working between the two companies in response to the recent demands made by the British stockholders of both companies that destructive competition between them should be checked.——A story has been started that the company proposes to build a bridge across the Niagara river and connect with the Rome, Watertown & Ogdensburgh road at Lewiston. The rumor has probably but little foundation in fact. ——Work on the grading of the Windsor extension is to be pushed as fast as possible. The contracts are to be let on Jan. 26, and the work is to be finished by July 1. The company will do the heavy work themselves. Right of way is nearly all secured. The line will run alongside the Grand Trunk nearly the whole distance. HENRY BEATTY, of Toronto, is negotiating for the transfer boats, which are to be equipped with the latest apparatus for ice breaking.

Detroit, Lansing & Northern.—McRae & Lally, the contractors who built the Grand Rapids, Lansing & Detroit Railroad from Grand Ledge to Grand Rapids, 53 miles, have brought suit for $500,000 damages, claiming that the delay in the location of the road caused the work to go over into the winter and so increased the cost that the contractors were heavy losers. The company has also delayed the payment of $100,000 balance due. WM. MCRAE, of Lockport, N. Y., a member of the firm, has just made an assignment to H. H. FLAGLER of the same place, his embarrassment being largely due to the trouble over the above mentioned contract;

South Pennsylvania.—The perennial report that this road is to be completed is again going the rounds. A son of the late Dr. HOSTETTER has been in New York and on his return to Pittsburg is reported to have said:

"The South Pennsylvania matter is at last settled. Messrs. M. W. WATSON, B. F. JONES, H. SELLERS MCKEE, and all the other Pittsburgers except H. C. FRICK and E. M. FERGUSON have signed the new agreement. Messrs. FRICK and FERGUSON have agreed to sign early next week when the VANDERBILTS do. This removes all the friction and means that the road will be completed. A great deal of the preliminary legal work has been done already, so there will not be much delay when the papers are signed. I think we have plenty of time in which to complete the road, but if we have not, and show that we really intend to build, I have no fear about getting the time extended. There will be a meeting soon of the South Pennsylvania people, when all details will be settled and a programme agreed upon."

Central Vermont.—The company has offered to build a branch from Waterbury to Stowe, Vt., about 8 miles, if the latter town will vote a subsidy of $40,000.

Ohio, Indiana & Western.—It is reported that negotiations are in progress for the sale of this road to the Erie. The line extends from Springfield, Ohio, west to Peoria, Ill., a distance of 342 miles.

Lackawanna & Pittsburg.—The extension from Wayland to Geneva, N. Y., about 40 miles, was graded two years ago; but unless the rails are laid before Sept. 1, 1889, the charter rights of the company are forfeited, and the right of way reverts to its former owners. Agents of the company are trying to secure an extension of time for the completion from the property holders along the line, but they are said to be meeting with poor success. If the company is unable to secure an extension, the line may be pushed to completion this summer. GEO. D. CHAPMAN, 48 Wall St., New York, is President and Receiver.

Maryland Central.—The stockholders of this reorganized Maryland company have elected WM. GILMOR of Baltimore, President. The company has just purchased the York & Peach Bottom railway in Pennsylvania, a narrow gauge line, 40 miles in length. President GILMOR states that the gauge of both roads will be made standard in the near future. The Deer Creek & Susquehanna, grading on which has just commenced, will be part of the Maryland Central system. The line is to run from Belair to the Susquehanna river, 16 miles. L. B. McCabe & Bro., of Port Deposit, Md., are the contractors.

Projects and Surveys.

Pittsburgh, Cannonsburg & State Line.—

HOPEDALE, O., Jan. 20, 1889.

EDITOR ENGINEERING NEWS:—This road is to run from Pittsburg, *via* Cannonsburg and West Middletown, to the State line on Buffalo creek, a distance of 40 miles. The surveys have all been made; work is light and the maximum grade will be about 1 per cent. There will be no bridges and few tunnels. The road will connect at Pittsburg and Wheeling with the several lines of railway centering there and will run through a good mining and manufacturing country. Good progress has been made in obtaining right of way and the prospects for securing other local aid are favorable. The President of the company is J. B. DONALDSON, of Cannonsburg, Pa. R. L. MCCULLY is Chief Engineer.

A. B. PAUL, *Secretary.*

[See also the Wheeling, Wellsburg & State Line in "Southern—Projects and Surveys."]

Sandusky, Ashland & Coshocton.—At a meeting of business men of Sandusky, O., the committee recently appointed to solicit subscriptions reported that the necessary $30,000 had been raised. It is hoped that the work of construction will begin soon.

Oakland & Confluence.—A project is said to be under way, backed by Philadelphia parties, to build a line of railway from Confluence, Pa., to Oakland, Md., and that right of way is now being secured.

Scranton & Forest City.—It is reported that grading has already begun on this Pennsylvania road.——A press report states that a moonlight survey was recently made through the city of Carbondale in order to avoid the Delaware and Hudson and several property owners who object to the proposed road running through the city.

Berlin & Canadian Pacific Junction.—This company will apply at the next session of Parliament for an act extending the time for commencement of construction for a period of three years, and amending the articles of incorporation by substituting Galts Station for Dumfries Station, wherever the latter occurs. The original project was to build from Berlin to Dumfries Station, and the amendment will, if granted, change the route making it from Berlin to Galt.

Dublin & Sellersville.—A company is to be formed in Pennsylvania to build a railroad from Dublin and Blooming Glen to Sellersville making connection with the North Pennsylvania railroad.

South Bethlehem & Utica.—Surveys are in progress for a line of railway running from South Bethlehem *via* Tarrytown, Clarksville, Remville, Central Bridge, Sloansville, Springfield, Jordan and Jerico, to Utica, N. Y. The engineering corps is in charge of W. A. SLINGERLAND, Jr., of the firm of Wm. H. Slingerland & Son, civil engineers, of Albany, N. Y.

Ridgefield & Yonkers.—It is stated that engineers have been at work surveying a road from Ridgefield, Conn., *via* Lewisboro, Bedford, North Castle, Greenville, Hartsdale and White Plains, to Yonkers, where conection is made with the New York & Northern to New York City.

Matane.—A bill is to be introduced into the Quebec legislature to incorporate the Matane Railway Co. The proposed road is to run from St. Octave de Metis to St. Jerome de Matane. Among the incorporators are Monsignor LANGEVIN and J. R. R. FISET.

Eastern.—A bill is before the Quebec legislature granting a charter to ORLANDO BARNES, of Lansing, Mich., J. NELSON ROGERS and JACOB THOMPSON, of St. Paul, Minn., and CHARLES LANGLIER, of Quebec, to build a line of railway from St. Jean Chrysostome, on the south shore of the river Chaudière, to a point on the western bank of the river Metapedia near the Intercolonial Railway bridge at Casupscull.

Gaspé Peninsula Short Line.—J. W. THOMPSON, C. E. FOWLER, WILLIAM LAVERY and others will introduce a bill into the Quebec legislature to incorporate a railway company by this name. The projected road will run from Gaspé to a point on the river Metapedia north of its junction with the Casupscull river.

Northern Central.—A bill will be presented to the Quebec legislature by W. STEVENS, of Detroit, E. G. ROGERS, H. JUSTUS, ACHILLE CARRIER and J. B. PROVOST, of Quebec, to incorporate a company to build a line of railroad from St. Charles to Ottawa.

Plymouth & Sandwich.—The surveys for this Massachusetts road are to be made at once, preliminary to applying for an act of incorporation at the present session of the legislature. One hundred thousand dollars capital stock has been subscribed. The road is to cost $250,000 and is to run from Plymouth through Manomet, Peaked Cliffs, Big and Little Herring Pond, and Cedarville to a point on the Cape Cod division of the Old Colony, between Bournedale and Sagamore, a distance of 16 miles. The company is an independent organization, but it is believed that the Old Colony will equip and operate the road after completion.

SOUTHERN—Existing Roads.

Roanoke & Southern.—The section of 29 miles from Martinsville, Va., south, has just been put under contract.

Atlantic & Danville.—The city of Portsmouth, Va., has voted $150,000 to this company, and the machine shops of the road will be established at that place. About 500 hands are at work on the grading near Danville. It is expected that track will be laid to Milton, N. C., in 60 days.

Ohio Valley.—The report that all work had ceased on the Hopkinsville extension proves to have been unfounded. The extension to Evansville, Ind., is nearly finished and trains are to begin running soon.

Augusta & Chattanooga.—A movement is on foot at Chattanooga, Tenn., to revive this enterprise. It is proposed to form a construction company with a capital of $500,000 and induce the city of Chattanooga to subscribe $500,000 in addition. This would place the control of the enterprise in Chattanooga hands. It is proposed to build the line *via* Athens, which would make its total length about 145 miles. Messrs. JAMES, BASKETT and HART, of Chattanooga, are interested.

Louisville, St. Louis & Texas.—The opening of the Owensboro & Henderson division has been unexpectedly delayed, owing to difficulty between the railroad company and the contractors who were building the Green River bridge. The press reports of the occurrence are conflicting, but it seems that for some reason the contractors began removing the track from the bridge after its completion, and that the dismantling in some manner upset the draw span, resulting in the death of one workman and the injury of several others.

Central Railroad & Banking Co. of Georgia.—It is stated that several minority stockholders of the company intend soon to test the control of the system by the Richmond & West Point Terminal Company in the courts.

Louisville & Nashville.—Surveys have just been finished for a short branch from Alum Springs to Shelby City, Tenn.

Tennessee Midland.—The city of Jackson, Tenn., will contest the payment of its $125,000 subscription to this company, claiming that the conditions of the subscription have not been complied with.

Norfolk & Western.—The contract for the extension of the Cripple Creek branch from Ivanhoe Furnace to Speedwell, about 15 miles, has been let to Geo. T. Mills.

Chattanooga & Lookout Mountain.—The last spike on this 10 mile road from Chattanooga, Tenn., to the top of Lookout Mountain was driven on Jan. 19.

Blue Ridge & Atlantic.—The report is revived that the extension of this road from Tallaluh Falls, Ga. north, is soon to be undertaken. There seems little reason to suppose that the company can obtain funds for the work at present.

Rome & Decatur.—At the annual meeting held at Rome, Ga., Jan. 17, EUGENE KELLEY, of New York, was elected President and F. M. BARNUM, Secretary. It is intended to secure a Court order for the sale of the road as soon as possible. It was the general sense of the meeting that as soon as the road is out of the receiver's hands, the company will begin work on the extension to Decatur, Ala.

Projects and Surveys.

Wheeling, Wellsburg & State Line.

HOPEDALE, O., Jan. 20, 1889.

EDITOR ENGINEERING NEWS:—There are two routes in contemplation for this road, both of which have been surveyed. One is from Wheeling, W. Va., *via* Buffalo Creek, Bethany and West Middletown to the State line, about 25 miles and the other *via* Cross Creek, and about the same distance. The road will have a heavy coal and lumber traffic and with the Pittsburg, Cannonsburg & State Line [elsewhere noted] will furnish a short line between Wheeling and Pittsburg, and tap the oil and gas regions of Washington county, Pa. SAMUEL GEORGE is President. The company was incorporated May 28, 1887. Capital for construction is guaranteed on condition that $5,000 per mile and free right of way are secured.

A. B. PAUL, *Secretary.*

West Virginia, Pineville & Tennessee.

PINEVILLE, Ky., Jan. 15, 1889.

EDITOR ENGINEERING NEWS:—The preliminary survey for this road, which is to run from a point on the Tennessee State line south of Pineville, *via* Pineville, east along Pine Mountain on the north side to the Breaks of Sandy, will begin Jan. 17, 1889. H. V. LOVING, of Pineville, is President and W. W. DUFFIELD is Chief Engineer. The company was incorporated March 24, 1888.

JAMES S. RAY.

Meriden & Tuscahoma.—A company has been organized in Mississippi with W. H. HARDY, of Meridian, President, C. W. ROBINSON, Vice-President, and JESSE BONDS, Treasurer, to build a line of railway 48 miles long. An engineering corps will start on the preliminary survey immediately.

Anniston & Montgomery.—Major C. C. WRENSHALL and a corps of engineers are now at work on the preliminary survey of this road, with headquarters for the present at Oxford, Ala.

Macon & Birmingham.—Chartered in Alabama to build a line of railroad from Macon to Birmingham. The Macon Construction Co. is to build the road.

Wythe County.—A project is being agitated, by the citizens of Wythe county, Va., to build a line of railroad through the counties of Wythe, Carroll and Bland at right angles to the Norfolk & Western.

THE NORTHWEST—Existing Roads.

Illinois Central.—The most important event of the week in financial circles was the announcement in the reduction in the rate of dividend of this company from 7 per cent. to 5 per cent. The 2½ per cent. semi-annual dividend just voted makes a total payment of 6 per cent. for the fiscal year. The company has issued a preliminary report to its stockholders in the form of a letter from General Manager JEFFERY to President STUYVESANT FISH. The reduction in the company's earnings is here ascribed to bad crops and lower rates caused by the sharp competition. Operating expenses also increased though bad weather and heavy requirements for the department of motive power. The report discusses the effect of the Interstate commerce law as follows:

"The current year brought the railways of the country face to face with the gravest problems. The old and tried methods, imperfect though they were, for maintaining rates and revenues were legislated out of existence.

The transportation interests of the country were cast adrift on the sea of competition, with its tidal waves of public hostility and adverse criticism. Conservatively managed systems like the Illinois Central suffered less during the troublous times than did the aggressive and rashly-competitive lines of railway in territory contiguous to or occupied in common with this line. * * *

"In the strife that ensued, reductions followed one another thick and fast, until the basis of 75 cents on first class freight between Chicago and the Missouri River was reduced to a twenty-cent basis, and other classes were cut down in about the same relative proportion. This rate war, unlike those of former times, affected the immense local traffic of all the lines which were drawn into the struggle.

"The disastrous war referred to affected the traffic of from 300,000 to 400,000 sq. m. of territory rich in industrial, agricultural and commercial resources; rich in all things that give value to railroads. Such, under the law, must be the effect of the aggressive action of one line of railroad upon another. The destruction of revenue in the contest reached as far south as the Gulf of Mexico and into the middle Southern States, to St. Paul and Minneapolis in the Northwest, and Omaha and Kansas City in the West and Southwest."

Mr. JEFFERY thinks it safe to assume that revenues will be larger this year than they were in 1888.

Lake Erie & Western.—During the past year this company replaced 2,200 lin. ft. of wooden bridges with iron, filled 3,000 ft. of trestling, and laid 135 iron pipe culverts with masonry protection.

Duluth, Red Wing & Southern.—The company has settled the controversy with the construction company which had the contract for building the road to Albert Lea. The road will be finished to Zumbrota as soon as possible, and whether it will be extended farther at present is not yet known.

St. Paul, Minneapolis & Manitoba.—It is stated that the company is negotiating with the Canadian Pacific managers for the purchase of the Emerson branch of that system, extending from Winnipeg to the boundary, about 60 miles.

Winona & Southwestern.—At the recent meeting of the stockholders of this company at Winona, the relative advantages of Sioux City and Omaha as future western termini were discussed, and it was voted that the Executive Committee of the Improvement Company and the Secretary of the Railway Company should visit Sioux City at an early date to examine the facilities offered at that point.

Indianapolis, Decatur & Western.—A corps of engineers under T. S. MARTIN began surveys on Jan. 21, for the extension from Decatur west to Beardstown, about 80 miles.

Projects and Surveys.

Sturgis, Deadwood & Bald Mountain.—Articles of incorporation have been filed for this new Dakota road. The line will run from Sturgis to Galena with a branch to Deadwood. Among the incorporators are, F. T. EVANS, of Sioux City, Dak., EDMUND SEYMOUR, of St. Albans, Vt., J. T. POTTER and J. J. DAVENPORT, of Sturgis.

Duluth, St. Cloud. Mankato & Austin.—It is reported that the surveys for this road have been completed, N. B. EVERETTS, of Minneapolis, is Chief Engineer.

Escanaba, Twin Cities & Western.—Officers of the Minneapolis, Sault Ste. Marie & Atlantic, express the opinion that this project must have a very slim backing. The officers of the company are MARCUS POLIASKY, President, Lieut. Gov. MCDONALD, Treasurer, and GEO. A. ROYCE, of Marquette, Secretary.—The recent sudden death of Mr. MCDONALD, who was one of the chief projectors of the enterprise, is likely to check it at its start.

THE SOUTHWEST—Existing Roads

Cleveland, St. Louis & Kansas City.—THOS. C. CLARKE, of New York City, has been elected President of this company in place of J. T. K. HAYWARD. The plans for the road include the erection of two large bridges across the Mississippi and Missouri rivers.

Chicago, Rock Island & Pacific.—The company has just purchased 37 city lots in Kansas City, on which additional freight terminals are to be erected.—The report that the company intends to build from Liberal, Kan., southwest toward El Paso, Tex., this year is still circulated.

Missouri Pacific.—Plans for the new St. Louis depot have been approved and the work of raising the north approach of the Fourteenth St. bridge is really the commencement of actual work upon the foundation. The new structure will be 3 stories in height with offices on the top floor.

Kansas City & Sabine Pass.—The citizens of Fayetteville, Ark., are anxious that this railway should be built through that town, and a committee has been conferring with officers of the road to this end.

St. Louis & San Francisco.—Delegates from the Harper, Kan., Board of Trade recently visited St. Louis, to try and induce the company to build an extension from Wichita to Harper, about 40 miles. The managers of the company stated that for the present the extension could not be undertaken.—The report that the company intends to build to Kansas City forthwith, appears again in the Kansas City *Times*. This project seems to come up with remarkable frequency, but there seems little to corroborate the story this time.

Atchison, Topeka & Santa Fé.—The train collectors on the system were removed on Jan. 20.

Projects and Surveys.

Nebraska, Kansas & Colorado—

ALLISON, Kan., Jan. 15, 1889.

EDITOR ENGINEERING NEWS:—This road is to run from a point on the Nebraska State line, southwest *via* Norton, Lenora, St. Johns county and Greeley county to Trinidad, Col., about 300 miles. The route has been surveyed from Lenora to Allison. The principal sources of traffic will be agricultural products, coal and lumber. Negotiations are in progress for right of way and local aid. Assistance is expected from the Union Pacific, some of whose officers are among the directors of the Nebraska, Kansas & Colorado, O. S. WANZER, of Hoxie, Kan., is president. The company was incorporated Dec. 21, 1888. JNO. J. CASS.

Press reports state that the use of the name of General Manager KIMBALL, of the Union Pacific, as one of the directors of this company, was unauthorized, and that he denies all connection with the project.

Colorado & Northern Kansas.—Incorporated in Kansas to build a line of railway running from the northern line of the State through the counties of Marshall, Washington and Republic to the western line of the State. Chief of offices will be at Topeka, Concordia, Lincoln and Marysville. Among the incorporators are, GEO. E. HUBBARD, A. P. MORRISON, J. A TRAUTMAN and J. H. DENNIS, of Topeka.

ROCKY MT. AND PAC.—Existing Roads.

Salt Lake & Eastern.—This new road starts from a point on the Salt Lake & Ft. Douglas R. R. in the southeast part of Salt Lake City and runs *via* Park Lake and Quarry Glen east toward Park City, a distance of 14 miles. The road is to be pushed to Park City, 18 miles farther, as fast as possible. By the articles of incorporation, it may continue its line to Kamas, Summit county, where it will tap valuable coal deposits. JOHN W. YOUNG, of Salt Lake City, is at the head of the enterprise.

Arizona & Southeastern.—Tracklaying has just been completed on this road from Fairbanks to Bisbee, Ariz.

Bellingham Bay Ry. & Nav. Co.—President EUGENE CANFIELD denies the rumors that this Washington Territory company has sold out to the Northern Pacific.—Clearing the right of way from New Westminster B. C., south to the International boundary is nearly completed, and the contractors expect to begin grading about Feb. 1. This northern division is to be completed ready for the rails by July 1. The company is asking for bids for grading the road from Whatcom north to the boundary, about 17 miles. The locating surveys are just completed.

Oregon & Washington Territory.—President G. W. HUNT is receiving offers from various towns who wish to secure an extension of this system during the coming season. The Board of trade of Walla Walla, which is to be the headquarters of the system will also aid the proposed extensions.

Mason County Central.—This lumber road is to run from Shelton to Gray's Harbor, W. T. About 6 miles are completed and the rails are purchased for 4 miles more. ALLEN C. MASON of Tacoma is interested.

Denver & Rio Grande.—The company is saidto be using the surveyed line of the Burlington & Missouri River Co. from Glenwood Springs to Grand Junction, under a contract by which the Burlington will have a trackage right over the line when completed.

Denver, Texas & Gulf.—The Denver City Council has granted right of way to this company and to the Denver & Santa Fé for an extension from the present terminus to the north line of Denver.

Projects and Surveys.

Anaconda.—Surveyors are at work locating a line of railroad from Butte, Mont., to Anaconda, Mont., about 27 miles. The road is to be built in the interest of the Anaconda Copper Co. and will probably be used for the transportation of ore and coal, only.

Deseret.—Incorporated in Utah to build a railroad from the Utah Coal & Iron Co's. mines in Emery county to the Denver, & Rio Grande Western. Among the incorporators are J. R. MIDDLEMISS, J. E. DOOLY, WM. VANDYKE, E. J. SWANER and HEBER YOUNG.

Stockton, Fresno & Southern.—Several changes are to be made in the route of this proposed road. According to the new surveys, the line will swing around so as to enter Stockton from the southwest, thence it will run southeast, crossing the Tuolumne river at a point one-half mile southwest of Waterford. It then runs to McSwain's ferry on the Merced river, thence south to Merced, Newton and Fresno. From Fresno the line runs east to Centerville, thence southeast to Visalia. Surveyors are now at work on that part of the line between the Tuolumne river and Merced. Twenty thousand tons of steel rails and 250,000 ties have been ordered.

Salt Lake City & Los Angeles.—At a meeting of the Salt Lake City Chamber of Commerce recently held, it was resolved to co-operate with the Los Angeles Chamber of Commerce in pushing the project to build a railroad from Salt Lake City to southern California. A committee was appointed to solicit subscriptions in addition to the $168,000 already subscribed.

Salt Lake, Nevada & California.—Incorporated in Utah to build a line of railroad to run from Salt Lake City west *via* Garfield beach to Grantsville, thence northwest to a point near Salt Springs, thence southwest to a point near Deep Creek, a distance of 150 miles. Among the directors are JAMES E. FULTON, Treasurer; THEO. BROUGH, ROBERT GARDINER and THOS. W. BATES.

Bellingham Bay & Whatcom Lake.—The survey for this Washington Territory road, running from Bellingham Bay to Whatcom Lake has been completed. The line will be used as a logging road only. P. B. CORNWALL, of Whatcom, is President.

Utah.—Surveys are in progress for a road to run west from North Salt Lake City, a distance of 10 miles. The road will be constructed from the lake shore to Antelope Island, a distance of 4 miles, on piles. Jeremy & Co., owners of salt lands through which the road is to pass, are interested.

Pacific Short Line.—The Salt Lake City *Tribune* characterizes the recent report that the contract for grading the Salt Lake & Los Angeles line was let, as "an idiotic item." It thinks, however, that if the contracts for the Pacific Short Line are not yet let, they soon will be; railway presidents and Eastern bankers opposition to railway construction it thinks will be ineffectual to prevent the building of the line.

FOREIGN.

Honduras.—The Government of British Honduras has called for tenders for the construction and operation of a railway from Belize west 90 miles to the frontier of the colony. The contractor is also to obtain a concesssion from the government of Guatemala for the extension of the line. The subsidy offered is a land grant of 5,000 acres per mile and $300,000 cash. The contractor is required to introduce 1,000 immigrants into the colony. Forms of tender can be obtained of the Colonial secretary at Belize, and bids will be received up to April 3, 1889, by the Crown Agent for the Colonies, Downing St., London, England, endorsed, "Tender for British Honduras Land Grant Railway."

RAPID TRANSIT.

Electric Railways.—***Boston, Mass.***—On Nov. 20, 1888, the Thomson-Houston Electric Co. started to equip the Cambridge Division of the West End Street Railway, from Bowdoin Sq., Boston, to Harvard Sq., Cambridge, (3 miles), and thence to Arlington, a distance of 4 miles. About 6 miles are double track and paved. It was decided to first equip the line as far as Harvard Sq., and the work of making the rail connections between Harvard Sq. and Bowdoin Sq., was completed Dec. 3, and was done without interrupting the traffic. The work of connecting the rails on North Ave. is about done. The poles are made of lengths of iron pipe shrunk together, and are set in concrete; three styles of these poles are used, it being deemed advisable to use stronger ones on curves than on tangents; 300 have been used between Harvard and Bowdoin Sq.; they are now being erected for the line to Arlington. The cross suspension method is used, and the wires are in position. In order not to interfere with the operation of the cars during this work, a large platform staging was used, which allowed the cars to pass under it. At the drawbridge a specially designed switch has been put in. At the grade crossing of the Boston & Albany, in order to avoid raising the trolley wires above the gate, an automatic device will be employed in connection with the gates to prevent interfering with the trolley wires. Twenty of the cars now running are being equipped, three being fitted up at a time. The company expects to have the line in operation by Feb. 1. The station of the Cambridge Electric Light Co. will be used and five 80 H. P. generators and complete switch board, etc., are being put in. Each car will have sufficient power to run a tow car, and will have electric lights and head lights.

Allentown, Pa.—The Allentown Passenger Ry. Co. proposes to build an electric railway to Bethlehem.

Washington, D. C.—The Rock Creek Ry. Co., of which GEO. H. TRUESDELL is president, will build an electric line 3 miles long.

Dummy Lines.—***Birmingham, Ala.***—The East Birmingham Land Co. will meet Feb. 11 to vote on the extension and more complete equipment of its road.—The Clifton Dummy Line Co. will build an extension to Oxmoor.

Huntsville, Ala.—The Shelta Caverns Land & Improvement Co. is having surveys made for a dummy line to the caverns, and will build the line this spring.

Dandridge, Tenn.—GEORGE A. FAIN, Jr., is interested in a dummy line to Mossy Creek. The line will be 10 miles long, standard gauge, and will carry freight and passenger traffic.

Elevated Railway.—***Brooklyn, N. Y.***—Holmes & Cogan, of Jersey City, N. J., have been awarded the contract by the Union Elevated Ry. Co. for the extension of the Myrtle Ave. line, east of Broadway.

CONTRACTING.

Wharf, and Pile Protection.—The following proposals for the construction of the Fremont St. wharf (with teredo resisting piles), at San Francisco, Cal., have been received by the State Board of Harbor Commissioners: San Francisco Contracting Co., $32,725; B. McMahon & Son, $33,550; San Francisco Bridge Co., $34,857; American Bridge & Building Co., $36,750; Pacific Bridge Co., $44,900; King Iron Bridge & Mfg. Co., $55,350. The contract was awarded to the San Francisco Contracting Co.—Bids were also opened for covering with Key West pile-armor the piles for this above wharf; W. Connell, 35 cts. per lin. ft.; San Francisco Bridge Co., 32.7 cts. The contract was awarded to W. Connell.

Rip-Rap.—The following proposals for furnishing and

placing rip-rap granite have been received by Major LIVERMORE, U. S. Engineer Office, Newport, R. I.:

Nantucket Harbor, Mass.—James Scully, Groton, Conn., $2.40 per net ton; Francis H. Smith, New York, N. Y., $2.47; James V. Luce, Niantic, Conn., $2.49; Wm. H. Molthrop & Co., New London, Conn., $2.60; Chas. H. Edwards, Quincy, Mass., $2.94.

Stonington Harbor, Conn.—Charles F. Stoll, New London, Conn., $1.07; James Scully, $1.20; William H. Molthrop & Co., $1.27; James V. Luce, $1.27; Francis H. Smith, $1.47.

Pipe.—***Milwaukee, Wis.***—The following proposals have been received for 1,550 tons of cast-iron water pipe: Addyston Pipe & Steel Co., $25.93 per ton for 3 and 4-in., $24.93 for 6, 8, 12 and 16-in., $24.55 for 30-in. McNeal Pipe & Foundry Co., $30.94 for 3-in., $29.38 for 4-in., $28.50 for 6-in., $28.05 for 8-in., $27.60 for 12-in., $27.27 for 16-in., $26.92 for 30-in. Wm. Runkel, $31.80 for 3-in., $30 for 4-in., $29 for 6 and 8-in., $28.25 for 12-in., $28 for 16-in., $27.25 for 30-in. Detroit Pipe & Foundry Co., $29 for 3-in., $28.25 for 4, 6, 8 and 12-in., $28 for 16 in. The contract was awarded to the Addyston Pipe & Steel Co.

Minneapolis, Minn.—The Water-Works Committee recently opened proposals for 4,960 tons of 6 to 24-in. pipe: Dennis Long & Co., Louisville, Ky., $27.40 for 6, 8 and 12-in., $26.75 for 16 and 24-in.; specials, $60 per ton. Addyston Pipe & Steel Co., Cincinnati, O., $26 for all sizes of pipe, $44 per ton for specials; Shickle, Harrison & Howard, St. Louis, Mo., $25.75 and $55 per ton; Warren Foundry & Machine Co., New York, $30 and $31.40 for pipe and 2¾ cts. per lb. for specials; Mellert Foundry & Machine Co., Reading, Pa., $30.80 and $31.40 for pipe, and 2¾ cts. per lb. for specials; R. D. Wood & Co., Philadelphia, Pa., from $23.78 to $29.72 for pipe and $50 and $72 per ton for specials; Jackson & Woodin Mfg. Co., Berwick, Pa., $30.50; McNeal Pipe & Foundry Co., Burlington, N. J., $29.50 to $31.29 for pipe and 2½ cts. per lb. for specials; Lake Shore Foundry, Cleveland, O., $27.75 for pipe and 2½ cts. for specials; Lockwood, Upton & Co., Minneapolis, 2½ cts. per lb. for specials; Minnesota Foundry Co., Minneapolis, 2 cts. per lb. for specials.

St. Paul, Minn.—The following proposals for 6,000 tons of 4, 6, 12, 16 and 20-in. pipe and 1,500 tons of special castings have been received by JNO. CAULFIELD, Secretary of the Board of Water Commissioners: Shickle Harrison & Howard Iron Co., St. Louis, Mo., $26.25 per ton for pipe, $50 per ton for specials. Dennis Long & Co., Louisville, Ky., $27.40 for 4, 6 and 12-in., $26.75 for 16 and 20-in.; $60 for specials. Addyston Pipe & Steel Co., Cincinnati, O., $27 for pipe, $55 for specials. H. P. Rugg & Co., St. Paul; $27.97 for pipe, $62.50 for specials. McNeal Pipe & Foundry Co., Burlington, N. J.; $32.40 for 4-in., $31.29 for 6-in., $30.39 for 12-in., $30.17 for 16-in., $29.72 for 20-in.; $47.50 for specials. R. D. Wood & Co., Philadelphia, Pa., $30.25, $29.72, $29.37, $28.98, $28.97; $50 for specials. Mellert Foundry & Machine Co., Reading, Pa.; $32.40 for 4-in., $31.40 for 6-in., $30.80 for 12, 16 and 20-in., $55 for specials. The contract was awarded to the Shickle, Harrison & Howard Iron Co. The contract for valves was awarded to the Galvin Valve & Hydrant Co., of Detroit, Mich.

Sea-Wall.—The proposals received Jan. 5 by S. S. HARVEY, Key West, Fla., for a concrete sea-wall, were as follows: Dennis McGee, Key West, $2,300; A. A. Brooks, Key West, $2,975.

Armory.—The Armory Board, New York City, received bids recently for the construction of the 22nd Regiment armory on the block bounded by 67th and 68th Sts., 9th Ave. and the Boulevard. The Board had advertised twice before, but each time the bids had exceeded the $300,000 appropriation. There were 35 bids, 4 being for the work complete, and 31 in detail. The lowest single bid for the work was from Mahoney & Watson, $273,000, while the aggregate of the lowest bids in detail was $266,970. These lowest bidders were as follows: James D. Murphy, mason work, $112,980; P. R. Lantry, carpenter work, $72,750; Wallis Iron Works, iron work, $59,000; C. Nally, plumbing and gas-fitting, $11,865; C. Nally, steam-heating, $10,375. The Board decided to award the contracts to these bidders.

Scows.—The following proposals for building 4 scows for the work of improvement of the James river, were opened Jan. 15 by Col. WM. P. CRAIGHILL, U. S. Engineer Office, Richmond, Va.: H. T. Morrison & Co., Petersburg, Va., $4,385.29; Joseph Allard, Jr., Richmond, Va., $4,996; James H. Cline and David R. Isaac, Richmond, Va., $5,175; Henry and Wm. Brusstar, Baltimore, Md., $5,246.52; Wm. E. Woodall & Co., Baltimore, Md., $16,000. The contract was awarded to H. T. Morrison & Co. The scows will be 68 ft. x 22 ft. on deck, 56 ft. x 21 ft. on bottom, with an outside depth of 5 ft.

Barges.—The following proposals for building 50 wooden barges were opened Jan. 17 by Capt. CHAS. F. POWELL, U. S. Engineers, at the office of the Mississippi River Commission, St. Louis, Mo.: Madison Marine Ry. Co., Madison, Ind., 10 barges, $2,575 each, and 10 barges, $2,625 each; E. J. Howard, Jeffersonville, Ind., 10 barges, $3,200 each; Ripley Mill & Lumber Co., Ripley, O., 10 barges, $3,250 each; Cincinnati Dry Dock Co., Cincinnati, O., 20 barges, $3,500 each; Thos. P. Morse, St. Louis, Mo., 10 barges, $4,774.50 each. Contracts were awarded to the first named firm for 20 barges, and to the next three firms for 10 barges each.

Piles.—The following proposals were opened Jan. 15 by Capt. SMITH S. LEACH, U. S. Engineer Office, Memphis Tenn.: J. J. Carr, Barfield, Ark., 35¼ cts. per lin. ft. for 35 ft. to 65 ft. long, 45¼ cts. for 70 and 75 ft.; total $6,595.38; Bodkins, Allen & Lewis, Bardwell, Ky., 9 cts. for 35 and 40 ft., 11 cts. for 45 to 55 ft., 12 cts. for 55 to 75 ft., $9,027.75; Hogan & Wright, Cairo, Ill., 8 cts. for 35 to 55 ft.; 10 cts. for 65 ft., 12 cts. for 70 ft., 15 cts. for 75 ft., $15,600.50; James R. Clemans, Memphis, Tenn., 8 cts. for 35 to 50 ft. 10¾ cts. for 55 ft., 12½ cts. for 65 ft., 13½ cts. for 70 ft. 14¾ cts. for 75 ft., $17,286; J. H. Bates & Co., Fulton, Tenn., 10 cts. per ft. for 35 and 40 ft. only, $3,705.

Dredging.—***Ogdensburg, N. Y.***—The following proposals for dredging about 87,760 cu. yds. in Ogdensburg harbor were opened Jan. 15, by Major M. B. ADAMS, U. S. Engineer Office, Burlington, Vt.: Wm. James Daly, Ogdensburg, N. Y., 14 cts., $12,286.40. Willard Johnson, Fulton, N. Y., 26 cts. per cu. yd. for 17,333 cu. yds., 22 cts. for 36,427 yds., 21 cts. for 34,000 yds., $19,660.52. E. J. Hinkston and Arthur Wood, Buffalo, N. Y., 17,333 cu. yds. at 35 cts., 36,427 yds. at 20 cts., 34,000 yds. at 22 cts., $21,001.95; W. S. Malcolm, Oswego, N. Y., 25 cts., $21,940.

Vicksburg, Miss.—The following proposals for dredging in Vicksburg harbor were opened Jan. 15, by Capt. WM. T. ROSSELL, U. S. Engineer Office, Memphis, Tenn.: John Maguire, Mobile, Ala.; will build plant for U. S. Govt. for $50,000, and do the work with it for 9 cts. per cu. yd. A. J. Whitney, Rock Island, Ill., 13 and 16 cts. per cu. yd. for long and short tow; W. R. Blackman, Moline, Ill., 12 and 15 cts. R. Moon, Mobile, Ala., 15 and 18 cts., finish in 18 months; or 19½ cts. for all, finish in 12 months.

Oakland, Cal.—The following proposals for dredging in Oakland harbor were opened Jan. 3, by Col. GEO. H. MENDELL, U. S. Engineer Office, San Francisco, Cal.: Von Schmidt & McNee, San Francisco; 32.95 cts., $32,950, for city front; 13.95 cts., $33,480, for jetty channel; $66,430. Pacific Coast Dredging & Reclamation Co.; 54 cts., $54,000 25 cts., $60,000; $114,000. San Francisco Bridge Co., San Francisco; 97 cts., $97,000; 27½ cts., $66,000; $163,000. California Bridge Co., San Francisco; 96 cts., $96,000; 56 cts., $134,000; $230,400.——The following proposals have been received for work in Napa river: San Francisco Bridge Co.; $3,100 for removing snags, 50 cts. per cu. yd. ($300) for removing gravel, $500 for removing rocks, $3,900; Meis Hanson & Wulff, Napa; $3,948, $1 ($600), $300, $4,848.

PROPOSALS OPEN.

Valves, Special Castings, Etc.—HENRY FLAD, President, Board of Public Improvements, St. Louis, Mo.

Street Improvement.—Grading, wood paving, etc. GEO. R. BRINGHURST, City Secretary, Houston, Tex. January 28.

Street Work.—Grading, curbing and paving, A. E. SMYRK, City Commissioner, Baltimore, Md. January 28.

Sewers.—JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. January 28.

Special Castings.—About 150 tons. THE WATER BOARD, Boston, Mass., January 29.

Gas.—Furnishing gas for streets and public buildings during 1889. JOHN P. ADAMS, Commissioner of City Works, Brooklyn, N. Y. January 30.

Dedging.—In slips at foot of Gold St. and Main St. JOHN P. ADAMS, (as above). January 31.

Water Bonds.—City water bonds for $100,000. JAMES BROWN, Comptroller, Allegheny, Pa. January 31.

Pier Work.—Removing old pier, and building new wooden pier (No. 7) at Coenties slip, East river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. February 1.

Dredging.—At pier 48, East river. THE DOCKS COMMISSIONERS, Pier A, North river, New York City. February 1.

Excavation.—About 300,000 cu. yds. of earth, for ditch 40 ft. wide and 10 to 30 ft. deep. Steam shovel, excavator or scraper plants. Work can be divided to suit contractors. Plans and specifications on file. LEWIS STOCKETT, Chief Engineer. A. F. BUNKER, Superintendent, Danville, Ill. February 1.

Building.—Court house and jail. THE COUNTY CLERK, Ballston Spa, N. Y. February 4.

Pipe, Gates, Etc.—Cast-iron water pipe, 792 tons of 6-in., 781 tons of 8-in., 472 tons of 10-in., 172 tons of 12-in.; 70 tons of specials; 681 stop-gates and boxes, 150 fire plugs with 4-in. stand-pipe; 15 tons of lead. JAMES BROWN, Comptroller, Allegheny, Pa. February 4.

Sewers.—Vitrified, salt-glazed sewer pipe, 12, 15 and 18-in.; receiving basins and manholes. ERNEST ADAM, City Surveyor, Newark, N. J. February 5.

Pile Bridge.—Span, 70 ft.; approaches, 40 and 20 ft. THE BOARD OF SUPERVISORS, San Luis Obispo, Cal. February 5.

Bridge.—Highway bridge across the bay of Quinte, at Belleville. Plans and specifications on file. U. E. THOMPSON, Secretary and Treasurer, Bay of Quinte Bridge Co., Belleville, Ont., Canada. February 11.

Electric Lighting.—Lighting streets and public buildings; separate bids. J. REYMERSHOFFER, Chairman, Special Committee on Lighting, Galveston, Tex. March 2.

GOVERNMENT WORK.

Road.—Macadamized road at Antietam. G. B. DANDY, Deputy Quartermaster General, U. S. A., Washington, D. C. February 3.

Iron Work.—Lighthouses at Holland Id. bar, Maryland, and Great Wicomico river, Virginia. Capt. J. C. MALLERY, U. S. Lighthouse Engineer, Baltimore, Md. February 13.

Dredging.—Removing broken rock from Flood Rock, Hell Gate, N. Y. Lieut. Col. G. L. GILLESPIE, U. S. Engineer Office, New York City. February 14.

Wire, Iron, Etc.—About 32,480 lbs. of steel wire; flange iron, sheet copper, etc. JAMES FULTON, Paymaster General, U. S. N., Navy Department, Washington, D. C. February 16.

MANUFACTURING & TECHNICAL.

Market Prices.—***Steel Rails.***—New York, $27.50 @ $28; Pittsburg, $28; Chicago, $30.

Railway Track Supplies.—New York; spikes, $2.0 @ $2.10; angle bars, 1.85 c. @ 1.90 c. Pittsburg; spikes, 2 cts., 30 days; splice bars, 1.80 c. to 1.85 c.; track bolts, 2.80 c. with square and 2.90 c. with hexagon nuts.

Structural Iron.—New York; sheared plates, 1.9 c. @ 2 c.; universal mill plates, 2 c. @ 2.1 c.; angles, 2 c. @ 2.10 c.; tees, 2.5 c. @ 2.6 c.; channels and beams, 2.8 c. all sizes; Chicago; car-load lots, universal plates, 2.15 c. @ 2.20 c.; angles, 2.15 c. @ 2.20 c.; tees, 2.45 c. @ 2.50 c.; small lots of angles, 2.35 c.; tees, 2.70 c.; beams, 2.90 c. for foreign and 3.50 for domestic.

Building Materials.—New York; Haverstraw hard brick, $7 @ $7.75 per 1,000; Jerseys, $6 @ $6.50; pale bricks $3.25 @ $3.50; Long Islands, $7 @ $7.25; Croton dark and red, $15 @ $16; Croton brown, $14 @ $15; Philadelphia front, $27 @ $28; Trenton front, $27. Rosendale cement $1.15 per bl.; American Portland, $2.10 @ $2.30; English Portland, $2.20 @ $2.30; German Portland, $2.30 @ $2.70; Rockland common lime, $1 per bl.; ditto finishing; $1.20; State common lime, 85 c.; ditto finishing, $1.10; St. John's lime, 95 c.; laths, $2.50 per 1,000 asked, with $2.25 offered; goats hair, 25 c. @ 28 c. per bushel; cattle hair, 18 c. @ 20 c.—San Francisco. Bricks; California hard, $8.50 per M, soft, $6; red, $7.50; stock, $12 to $14; pressed, $30 to $40; English fire, $50. Cement; Rosendale, $2.75; Portland, $3.50 to $3.75. Santa Cruz lime, $1.50 to $1.75 per bl.; Golden Gate plaster, $2.75 to $3; Eastern, $3.25; marble dust, $3; brickdust, $3.50.

Pumps.—The following contracts have been received by H. R. Worthington, of New York, since Jan. 1, for horizontal, high duty pumping engines: one of 12,000,000 galls. daily capacity, to work on direct pressure, for the city of Binghamton, N. Y.; one of 7,000,000 galls. daily capacity for the Chattanooga Water Co., of Chatanooga, Tenn., and one of 8,000,000 galls. daily capacity for the Quincy mine at Hancock, Mich.

Locomotive Works.—The King Locomotive & Car Works have leased the extensive grounds and shops of the Pennsylvania Railroad Co., at Bordentown, N. J. The open yard room covers 4 acres and the buildings recently remodelled cover 28,350 sq. ft. A stock of second hand locomotives and cars will be kept ready for inspection and early delivery.

The Canadian Locomotive Works, at Kingston, Ont., are to be enlarged, and the Kingston Foundry has been purchased.

Railway Material Wanted.—Rails, 2 dummy engines and 2 passenger cars are wanted by W. C. SHERROD, of Florence, Ala.

New or second-hand light rails (about 16 lbs. per yard), and a light locomotive are wanted by the Wewoka Mining & Mfg. Co., of Alpine, Ala.

Steel rails, 2 dummy engines, cars, etc., for a dummy line, are wanted by J. J. SEAY, of Rome, Ga.

Equipment for a dummy line is wanted by GEO. A. FAIN, Jr., of Dandridge, Tenn.

Drawing Instruments.—An instrument having an improved joint, with hairspring attachment, and an improved protractor, with micrometer adjustment, are manufactured by Theodore Alteneder, of Philadelphia. The Alteneder instruments have been adopted for use in the Rose Polytechnic Institute, of Terre Haute, Ind.

Cable Railway Castings.—The Cleveland Foundry Co., of Cleveland, O., has an order for a large quantity of castings for the Los Angeles Cable Railway Co., of Los Angeles, Cal.

Cattle Guards.—The National Surface Guard Co. has recently turned out 140 guards for the Elgin, Joliet & Eastern Ry. and 20 for the Southern Pacific Ry. They are made of iron strips ⅜-in. thick and 3 and 4 ins. deep alternately; they weigh about 600 lbs. each.

The Detroit Spiral Tube Co. has been organized at Detroit, Mich., with a capital stock of $100,000.

Creosoting Works.—The Carolina Oil & Creosoting Co., of Wilmington, N. C., is making additions to its works. F. C. PRINDLE is the Engineer and Superintendent.

Catalogues.—The Lidgerwood Mfg. Co., of New York, has issued an illustrated catalogue for 1889; giving particulars of its hoisting plant, etc.

The Empire Well Auger Co., of Ithaca, N. Y., has issued advance sheets of an illustrated and descriptive catalogue of drilling machinery for wells from 100 to 4,000 ft. deep.

Electric Locomotive.—The New York Locomotive Works, Rome, N. Y., have a contract to build an electric locomotive for the Darling Electric Locomotive Co., of New Jersey. The contract only covers the frame, wheels, shell of boiler, etc.; the electrical part being supplied by the patentee, Mr. Darling.

The Kentucky Improvement Co. has been organized at Louisville, Ky., to deal in railway supplies. Capital stock, $500,000. F. D. Carley is interested.

Mitis Steel.—The Solid Steel Co., of Alliance, O., has erected a building for making castings by the Mitis process.

Asphalt is being mined near Elizabethtown, Hardin Co., Ky., by W. L. Breyfogle, who has leased the deposits. The product is shipped east to be worked up for commercial use, but steps are being taken to establish works near the deposit.

The Revolving Semaphore Co. has been incorporated at Chicago by A. T. Leman, Fred T. Bennett and W. S. Brewster. The company has a capital stock of $250,000, and will manufacture railway signals, etc.

Brake Works.—The American Brake Co., of St. Louis, Mo., (now controlled by the Westinghouse Air Brake Co.), will expend about $25,000 for new buildings and plant.

The Eames Vacuum Brake Co., of Boston, Mass., has built a new shop. There are several orders on hand.

The Boyden Power Brake Co., will soon begin the construction of works at Baltimore, Md., for the manufacture of brakes for engines and cars.

The Pennsylvania Steel Co., Steelton, Pa., is very busy in its frog, switch and signal department. The company has recently completed an order for 40,000 railway ties at its works at Bellaire, W. Va.

Pipe Works.—The Chatanooga Foundry & Pipe Works, of Chattanooga, Tenn., will be enlarged.

Correction.—The copy of the order from Alameda, Cal., to the National Meter Co., for 200 Crown meters to which we called attention in our last issue, under the heading of "A Good Advertisement of a First Class Article", was inadvertently omitted; it will appear this week in their advertisement.

Bridge Works for Sale.—The lands, plant, machinery, franchises, etc., of the Decatur Iron Bridge & Construction Co., of New Decatur, Ala., will be sold, under a decree of the Chancery Court, at Decatur, Ala., on Feb. 18, by EDWIN THACHER, Trustee, of Decatur. There are 15 acres of land; a main building 90 x 300 ft. and two extensions 60 x 75 ft. The real estate is valued at $44,000 and the buildings, machinery, etc., at $63,300. The machinery includes engine, boiler, machine tools, Westinghouse electric light plant of 100 lights, etc., and a large assortment of small tools. New Decatur is said to be a flourishing and growing city, in which are located extensive shops of the L. & N. Ry. Co., car wheel works, chemical works, etc. Particulars may be obtained of the Trustee, who has authority to make private sale of the property as an entirety, at any time previous to the date set for public sale, at not less than $55,000.

Rotary Snow Ploughs.—The Cooke Locomotive Works, of Paterson, N. J., have finished a Leslie patent rotary snow plough for the Chicago, Rock Island & Pacific, and are building 7 more for other roads.

Ferry Boat.—The Canadian Pacific will put on the river at Detroit, in connection with its new line, the most powerful car transfer ferry boat on the river, Mr. HENRY BEATTY, Supt. of the Boats, has prepared the plans and is advertising for proposals.

Traction Engine.—A traction engine of 6 or 8 H. P. is wanted by Geo. B. Wright, of Dixon Mills, Ala.

The Dickson Car-Wheel Co. has been incorporated at Houston, Tex., by H. H. DICKSON, A. D. BANTA, and others. Capital stock, $50,000.

The St. Joseph Steel Car Co. has been organized at St. Joseph, Mo., and has purchased ground and let contracts for buildings. Passenger, freight and street cars will be built. President, Gen. ANDERSON; General Manager, H. D. PERKY.

The American Railway Equipment Co. has been incorporated in New York. President, O. S. BURR; Superintendent, A. S. HATCH. Capital stock, $1,000,000.

Steel Railway Spikes.—The Etna Iron Works, New Castle, Pa., are experimenting with a new method of manufacture. The object is to make a finished article by rolling the bar so that its width will be the length of a spike and in such a shape that the spikes may be cut from it with shears, as a cut nail is made except that the head is formed in the rolling process. The first test was made with steel rails that had been slowly heated, and the result was fairly successful.

Frogs and Crossings.—The Cleveland Frog & Crossing Co., of Cleveland, O., has been very busy with orders lately.

The Northwestern Contracting Co. has been incorporated at Chicago, Ill., by H. P. REIGART, G. T. SPILMAN and H. V. DONALDSON, to undertake engineering, architectural and construction work. Capital stock, $25,000.

Steel Rails.—Carnegie, Phipps & Co., of Pittsburg, have contracts for the Pennsylvania and the Wheeling & Lake Erie.—The Joliet Steel Co., of Joliet, Ill., have an order for the Fort Worth & Rio Grande.

Car Works.—The Tyler Car & Lumber Co. has been organized at Tyler, Tex., with a capital stock of $100,000. President, A. L. CLARK.

The Ellis Car Co., of Amesbury, Mass., has erected a large building for the construction of street railway cars.

The Burton Stock Car Co. has extensive works at Wichita, Kan. The capacity is 10 cars per day, and it is intended to undertake the manufacture of refrigerator cars and street railway cars.

The Minnesota Car Co. has built extensive works at Duluth, Minn., and will put in a very complete plant. The buildings are of brick, with iron roofs. The contract for 9 boilers, 6 ft. x 18 ft., has been awarded to the Stearns Mfg. Co., of Erie, Pa.

The Standard Car Co. has been organized at Bridgeport, Conn. President, STANLEY GOODWIN. Capital stock, $40,000.

The American Car & Equipment Co., of New York, has filed a certificate of incorporation at Charleston, W. Va.

Cars.—The U. S. Rolling Stock Co., of Anniston, Ala., has orders on hand aggregating 6,000 cars.

The Elliott Car Co., of Gadsden, Ala., has turned out 20 box cars for the Alabama Great Southern.

The Pullman Car Co., of Pullman, Ill., has turned out 200 coal cars for the Colorado Midland.

The Buffalo Car Mfg. Co., of Buffalo, N. Y., has built 500 gondola cars for the Western New York & Pennsylvania. Orders are in hand for 200 box cars of 50,000 lbs. capacity for the Cleveland, Columbus, Cincinnati & Indianapolis, and 150 box cars for the Delaware & Hudson.

The Helena Motor Railway Co. will give out orders for new rolling stock.

The Wisconsin Central Railway Co. will order 500 freight cars.

The Pennsylvania Co. is reported as about to order 2,000 freight cars for the lines west of Pittsburg.

Locomotives.—The Rogers Locomotive Works, of Paterson, N. J., have completed 2 consolidation engines for the Louisville & Nashville.

The Rhode Island Locomotive Works, of Providence, R. I., have delivered 5 moguls for the Toledo, Kansas City & St. Louis, and are building 10 ten-wheel engines for the same road.

The Baldwin Locomotive Works, of Philadelphia, Pa., are building some consolidation engines for the Louisville & Nashville; they are fitted with the Beckert balance valve the invention of Mr. A. BECKERT, Master Mechanic of the L. & N. at Birmingham, Ala.—The works are also building 4 consolidation engines, with cylinders 20x24 ins. for the Western New York & Pennsylvania. Also 10 narrow gauge engines for the Mexican Interoceanic.

H. K. Porter & Co., of Pittsburg, Pa., have orders in hand for engines for railways in several States, and Government orders for two points in Oregon. Also foreign orders for Japan, Argentine Republic and Brazil.

The Pennsylvania Railroad Co. will, it is reported, purchase 40 more engines for the lines west of Pittsburg.

BRIDGES AND CANALS.

Bridge Notes.—***York, Me.***—A bridge is projected from Cape Neddick to Ogunquit.

Woodland, Me.—The Maine Central is building an iron bridge at the outlet of Philips lake, to replace the existing old wooden bridge. This is to enable the Bar Harbor express trains to cross without slowing up.

Brattleboro, Vt.—The Berlin Bridge Co., of Berlin, Conn., is building a bridge over the Connecticut river between Brattleboro and Chesterfield, N. H.

Albany, N. Y.—A bridge across the railway tracks at East Albany is projected.

Niagara Falls, N. Y.—It is reported that a new bridge over the Niagara river can be built by May or June.

Elkton, Md.—The Philadelphia, Wilmington & Baltimore will build an iron bridge over the Little Elk river.

East Liverpool, O.—It is proposed to build a bridge over the Ohio river.

Wheeling, W. Va.—It is proposed to build a stone bridge over Wheeling creek at a cost of $74 000.—The Wrought Iron Bridge Co., of Canton, O., is building an iron bridge over Woods run for the Elm Grove Ry.

Parkersburg, W. Va.—The costs of bridges over the Little Kanawha river are estimated as follows: Juliana St., $64,000; Market St., $58,000; Avery St., $70,000; 4th St., $75,000; 5th St., $75,000; George St., $72,000.

Grafton, W. Va.—The Baltimore & Ohio will rebuild its bridge over the Tygart's Valley river.

Fayette, W. Va.—The Wrought Iron Bridge Co., of Canton, O., is building a bridge over New river.

Pulaski, Tenn.—The county court of Giles Co. has appropriated $7,000 for a new bridge over the Elk river.

Muskegon, Mich.—A toll bridge, 3,300 ft. long, is to be built between Muskegon and North Muskegon.

St. Joseph, Mich.—The West Michigan Ry. Co. is building a bridge to connect with Benton Harbor. There will be a draw 231 ft. long, with a masonry pier.

Fisher, Ill.—The new iron bridge over the Sangamon river, 1½ miles northeast of the town, is completed.

Chicago, Ill.—Shailer & Schniglau have the contract for a 200 ft. drawbridge over the Chicago river, at Deering St.

St. Paul, Minn.—The Chicago, Milwaukee & St. Paul Ry. Co. has been notified by the city that it must bridge its tracks at St. Clair and Lexington Aves.

St. Charles, Mo.—Plans for the Femme Osage bridge have been prepared by the County Engineer.

Denver, Col.—R. Jackson has the contract for the bridge over the Platte river at Alameda Ave.

Laredo, Tex.—The Rio Grande bridge is being built by the Smith Bridge Co., of Toledo, O., for the International Bridge & Tramway Co., of which Dr. P. ORNELAS, of San Antonio, is president.—An iron bridge of 75 ft. span is to be built over the creek. For information address the mayor.

Vernon, Tex.—An iron bridge across the Wichita river is to be built by the County Commissioners of Taylor and Wilbarger counties.

Longueuil Canal.—Work is reported to be progressing for this Canadian canal, and a company is being organized. It is proposed to construct it from Longueuil to join the Chambly canal. Messrs. MALINGRE and VINCENT are the engineers, and of the 9 miles, 3 miles are surveyed.

ELECTRICAL.

Electric Lighting.—***Abington, Mass.***—The Abington Electric Light & Power Co. has been incorporated by J. R. LOVEJOY, W. A. STILES and W. P. SHERMAN. Capital stock, $25,000.

Green Island, N. Y.—The village is to be lighted by electricity. The contract will be for 4 years.

Dansville, N. Y.—The Dansville Electric Light Co. has made a proposition to light the village for $1,962 per annum. The village now pays $1,195 for gas and kerosene.

Holley, N. Y.—The question of lighting the village by electricity is being discussed.

Connellsville, Pa.—Propositions to put in electric light plants have been made by the Keystone Construction Co., of Pittsburg, and by Stern & Silverman, of Pittsburg. The former company propose to use the Westinghouse system, while the latter firm is the Pennsylvania representative of the Edison system.

Philadelphia, Pa.—The Electrical Committee of Councils has reported favorably on the application of the Penn Electric Light Co. for an extension of 2 years of the time for the completion of its conduit system.

Augusta, Ga.—A local company has been organized to put in a Thomson-Houston plant. President, W. H. FLEMING. Capital stock, $300,000.

Rome, Ga.—The Crown Electric Light Co. has been organized to put in an incandescent plant. C. M. SEAY is interested.

Birmingham, Ala.—The Merchants' Electric Light & Power Co. has been organized by GEO. C. KELLY, A. W. FULLER and R. ROCHESTER. The Westinghouse system will probably be used. Capital stock, $25,000.

Baton Rouge, La.—The city has accepted the proposition of J. H. ANDREWS to light the city by the Van-Depoele system for 3 years at $1,800 per annum. There are to be 20 arc lights of 2,000 c. p. and the plant is to be in operation by March 16.

Slater, Mo.—The city council has awarded a contract for an electric light plant with 60 arc lights.

Canon City, Col.—An electric light franchise has been granted, and a party with capital is wanted to put in the plant. Address Dr. F. P. BLAKE.

Galveston, Tex.—Proposals for lighting the city for 5 years after the expiration of the present contract with the gas and electric light companies, have been received from the Galveston Gas Co.; Miller & Tyson, Wilson, N. C.; Edison Electric Light Co., New York; Brush Electric Light Co., Galveston; Frank S. Marr, Pittsburg, Pa.; Western Electric Co., Chicago. All the bids were rejected on account of their not meeting the requirements. New proposals are now being advertised for, and will be received until March 2.

East Dallas, Tex.—The Queen City Electric Light Co., of Dallas, has offered to put in electric lights, with a minimum number of 20, for $96.60 each per annum.

Houston, Tex.—The Jenney Electric Light Co., of Fort Wayne, Ind., will put in an electric light plant, at a cost of about $100,000, in accordance with a contract made some months ago.

Toronto, Ont.—The Consumers' Gas Co. will put in an electric light plant, using the Westinghouse system.

The National Electric Co., of New York City, has been incorporated by H. C. COMEGYS and others. Capital stock, $20,000.

WATER AND MUNICIPAL.

Water-Works.—***New Hampshire.***—The Weirs. The Weirs Water-Works Co. has been organized.—Manchester. At the end of 1888, the city had 26.773 miles of cement-lined pipe and 24.791 miles of cast-iron pipe; also 842 meters.

Massachusetts.—Holbrook. The Water Commissioners have been authorized to defend all suits brought against the town for damage on account of the water-works

Two suits are now pending: one for $20,000 brought by Langford, the contractor who laid the pipe; and one against the towns of Randolph, Holbrook and Braintree for several hundred thousand dollars brought by the millowners i the vicinity of Great pond.——Pittsfield. The Water Commissioners propose to put down a number of gang wells in the Sackett meadow, with a pumping plant to force the water to the Ashley reservoir.——Boston. The Brush Hill Water Co. has been organized. President ARTHUR WAINWRIGHT; Secretary, C. S. RACKEMANN.

New York.—Albany. The test of the driven wells put down by Andrews Bros. for the new water supply will be commenced about Feb. 15.——Saugerties. The village will make a contract with the water company for the use of hydrants for fire purposes.——Brooklyn. The West Brooklyn Water Co. has been organized by GEO. A. ALLIN and H. B. HUBBARD, of Brooklyn; MICHAEL MCCORMACK, of New Utrecht, and WM. A. INGHAM and FREDERICK SNYDER, of Philadelphia. Capital stock, $15,000.

New Jersey.—Long Branch. The Hyatt filter plant is reported to be working satisfactorily.

Pennsylvania.—Reading. The Water Commissioners have purchased 13,000 ft. of 24-in., 11,000 ft. of 30-in. and about 200 ft. of 40-in. cast-iron pipe, with specials, etc., for the Maiden creek water supply.

Virginia.—Norfolk. It is proposed to extend the water mains to Brambleton.——Franklin. Water-works are projected.

North Carolina.—Asheville. Land has been purchased for the site of the Hyatt filter. The filter will cost $7,225, and a new pump is being built which will cost $6,500.——Elizabeth City. Water-works are projected. For particulars address the mayor.

Georgia.—Cartersville. Mr. Porter, the contractor for the water-works, will commence work very soon.

Alabama.—Anniston. T. G. Bush, of Mobile, will begin the construction of the water-works very soon.

Louisiana.—Amite City. A well is to be sunk for a water supply for fire purposes. For particulars address R. W. READ.

Tennessee.—Johnson City. J. J. Robinson has the franchise for water-works; they are to be completed in 12 months. Surveys are being made.——Memphis. The Cook Well Co., of St. Louis, has contracted to furnish the water works with an additional supply of 6,000,000 galls. per day.

Ohio.—Milford. Water-works are projected; they will probably be built by the city unless a satisfactory proposition for a franchise is made.

Illinois.—Keeler & Co., the contractors for a water supply from the lake, will begin work soon. The plant will include a water tower and filter.

Kansas.—Horton. The council has rejected all bids or propositions for the construction of water-works.——Lawrence. The water company has sued the city for hydrant rental; there has been trouble between the company and the city about the quality of the water.

Nebraska.—Central City. The new works are not yet completed. WM. PATTERSON is mayor.

Missouri.—Washington. A satisfactory test of the new works has been made by the Washington Water & Light Co.; four 1-in. streams were thrown to a height of 100 ft.——St. Louis. A break occurred recently in the new 36-in. main to the new water tower; about 500,000 galls. of water were wasted, but as the main was not yet in service no loss happened to the city's supply.

Texas.—Cleburne. Propositions have been received for constructing water-works. For particulars address the mayor.

Colorado.—Pueblo. The Trustees of the Water-Works propose to double the capacity of the North Side works, as the city is growing very rapidly. The present pumping capacity is 50,000,000 galls. per day.

Washington Territory.—North Yakima. The city council has granted to GEO. F. WOOLSTON a 25 years franchise for water-works; the works are to cost about $100,000.

Utah.—Salt Lake City. The Superintendent of Water-Works fears a water famine next summer unless copious rains fall in the spring, and intends pushing the construction of the new reservoir as fast as possible. It is being built by convict labor.

Newark, N. J.—The Aqueduct Board has accepted the proposition of the Lehigh Valley Railroad Co. to give the city a new water supply, and has asked the Common Council to concur. The company proposes to supply the city at $39 per 1,000,000 galls., and agrees t furnish a plant that will supply 50,000,000 galls. of water per day, with a conduit capable of conducting 25,000,000 galls. per day, and to deliver the whole plant to the city within 15 months, for $6,000,000.

New Croton Aqueduct.—The proposals received by the Aqueduct Commissioners, New York City, for clearing the ground for the East branch reservoir, ranged from $11,000 to $45,000. The engineer's estimate was about $3,000.

Sewerage.—*Manchester, N. H.*—The annual report of WINFRED H. BENNETT, City Engineer, states that 2.38 miles of sewer pipe were laid last year, making a total of 38.23 miles.

Olneyville, R. I.—The Metropolitan Construction Co. is having considerable trouble in the construction of the Valley St. sewer, owing to quicksands and water.

Watervliet Arsenal.—Sewers are to be built at this arsenal, West Troy, N. Y., at a cost of $2,500; they will discharge into the river.

White Plains, N. Y.—The Board of Trustees have, under their sewer act, had Engineer JOHN H. CARPENTER run a line of levels from that village to tidewater in Long Island Sound for an outlet, but the State Board of Health has informed the village authorities that they cannot be allowed to empty their sewers into the Sound.

Baltimore, Md.—City Commissioner SMYRK, in his annual report, recommends the construction of a number of sewers during the current year.

Brunswick, Ga.—The Sewerage Committee has advised that bonds be issued and work commenced at once The cost is estimated at $112,000.

St. Augustine, Fla.—Plans for the sewerage system have been prepared by F. W. BOWDITCH, of Boston, Mass. The cost is estimated at $176,000 including the pumping station, or $141,000 without.

Pensacola, Fla.—Work on the sewerage system is progressing rapidly and will be completed this summer.

Vicksburg, Miss.—The sewerage question is again being agitated. C. DELAFIELD, of New York, Chief Engineer of the Vicksburg Water Supply Co., estimates the cost at $1.50 per lin. ft., or about $90,000.

Fort Smith, Ark.—The following is the work completed up to Jan. 1: 33,415.50 ft. of 8-in. pipe, 9,302.72 ft. of 10-in., 6,800.50 ft. of 12-in., 700.15 ft. of 15-in., 711.25 ft. of 18-in., 5,714.10 ft. of 21-in., 1,598.20 ft. of 24-in.; and 2,321 ft. of 26x36-in. brick sewer; total, 60,563.42 ft. The remainder of the system is mostly 8-in. The excavations have been from 0 to 36 ft. deep. The expenses to January on the sewer proper were about $82,000. JAMES P. BATES is the engineer

Helena, Mont.—The sewers now being built are for the "separate" system, for house sewage only; and G. N. MILLER, C. E., recommends box flumes for storm sewers, until permanent brick sewers can be built; these permanent sewers would cost about $10 per ft.

Los Angeles, Cal.—The Pacific Sewerage Co., that controls the West system of sewage disposal, has made an additional offer to the trustees. The company will build a plant at San Pedro St., where an outfall sewer now discharges, and if the city authorities are satisfied that the company can handle the sewage as claimed, then two more plants are to be built where different sewers empty, and the entire sewage will be used. The city to pay $50,000 and $10,000, or to pay $50,000 and give a franchise for 50 years.

Toronto, Canada.—During the past year the city built 21 miles of sewers, also 16 miles of improved roadways; the total expenditure by the Works Department was $1,200,000.

Court House.—Messrs. Bartlett & Thompson's plans for the new court house at Rosedale, Bolivar Co., Miss., have been accepted. Size of building ,60 x 80, two stories. Estimated cost, $30,000.

Garbage Removal.—At Birmingham, Ala., the following proposals have been received for removing garbage during 1889; garbage is to include all house slops and closet matter in unsewered portions of the city. Bidders not proposing to furnish their own dumping ground were instructed to figure on an average haul of 2¼ miles to the dumping ground used by the city: Going & Lambert, $1,150 per month; C. K. Dickey, $1,230; Lacy & Austin, $1,230; D. L. Bridges, $1,250; J. M. Maxwell, $1,540. The contract was awarded to Going & Lambert, who have their own dumping ground. This work has hitherto been done by the city, requiring 10 to 12 teams and costing $1,300 to $1,350 per month. J. R. CARTER is City Engineer.

Tipton, Ia.—The following proposals for water-works were received Jan. 15 by A. LANGHAM, Mayor: Geo. C. Morgan, Chicago, $10,297; F. Turner, Nevada, Ia., $11,000; Whiting & Wynn, Cedar Rapids, Ia., $11,156; M. Tschirgi, Dubuque, Ia., $11,950; all these bids were made on plans furnished by Geo. C. Morgan; Whiting & Wynn also bid $13,262 on plans of their own. Shickle, Harrison & Howard, St. Louis, Mo., bid on the cast-iron pipe. The contract was awarded to Geo. C. Morgan.

Special Reports of Water-Works Construction.

Housatonic, Mass.

120 BROADWAY, N. Y. City, Jan. 19, 1889.

EDITOR ENGINEERING NEWS:—The construction of these water-works was begun July 20, and they were put in operation Dec. 1, 1888. G. P. FERRIS, of Jersey City, N. J., was the designing, and T. Z. POTTER, of Housatonic, the constructing engineer, and the latter now acts as superintendent. The works are owned by the Housatonic Water Co. and were built at a cost of $60,000. The company has a capital stock of $40,000, and issued $40,000 in bonds. The officers are: HENRY S. HANIGAN, President; O. C. HOUGHTALING, Treasurer. The pipes and specials were furnished by M. J. DRUMMOND, of New York, and the trenching and pipe laying was done by Ferris & Halladay, of Jersey City, N. J. The New York hydrants, Ludlow valves and Crown meters were used. The supply is taken from Long Lake, which has an area of 160 acres, and is conveyed through six miles of cast-iron pipe, by gravity. There is a regular pressure of 75 lbs.

There are 60 taps, 2 meters and 16 hydrants. Population of town 1,500. HENRY S. HANIGAN.

Broken Bow, Neb.—A report has been received from Mr. O. P. PERLEY, regarding the new water-works at this place. Construction was begun Nov. 1, 1888, and will be completed in February, 1889. There are to be 3¼ miles of 4, 6, 8 and 10-in. cast-iron pipe, and 34 hydrants. The works will be owned by the Broken Bow Water Co., which has a capital stock of $50,000 and $25,000 of bonds. The franchise is for 20 years, with a rental of $85.00 per hydrant until 150 water takers are secured, and $75.00 per hydrant thereafter. The officers of the company are: JOHN REESE, President; O. J. COLLMAN, Secretary. The designing and constructing engineer was GEO. W. STURTEVANT, of Minneapolis, Minn. The contract for works as above described was awarded to C. A. WEEKS, of Broken Bow, and includes a brick pumping station, a 1,000,000-gall. Worthington pump, 60 H. P. boiler and a reservoir of 1,250,000 galls. capacity. The contract price was $37,500. Mr. WEEKS is now acting as Superintendent. Ten wells 100 ft. deep, have been sunk, in which the water rises nearly to the surface. Holyoke hydrants and Peet valves are being used.

CAMDEN, Ark., Jan. 15, 1889.

EDITOR ENGINEERING NEWS:—The Camden Water-Works Co. has closed a contract with J. Walker Bates & Co. of New York City, for a system of water-works. The present plant is designed for direct pumping, but it will probably be changed to a stand-pipe system. The probable cost of the works is $20,000, of which $16,000 in stock has been subscribed. The officers of the company are: S. Q. SEVIER, President; T. J. GANGHAM, Secretary and Treasurer. The designing and constructing engineer is T. F. HALL. The works will be completed about April 15. One and one half miles of mains will be laid at once, to afford fire protection to the business part of the town during the winter, and the remainder of the work finished in the spring. The Ouachita river, from which the new supply is to be taken, is a clear pure stream, free from grit or saline matter. Population of the town is 3,000.

S. Q. SEVIER, *President.*

BROWNSVILLE, Tex., Jan. 11, 1889.

EDITOR ENGINEERING NEWS:—If a company can give this community any inducement and take city bonds, the city fathers may erect water-works. Up to date nothing has been done toward securing works. The present supply is from wells and the Rio Grande river. Address M. B. KINGSBURY. BENJ. KOWALSAL

PALOUSE CITY, W. T., Jan. 8, 1889.

EDITOR ENGINEERING NEWS:—Our water-works have been in operation about a month. They are owned by the town and were designed and built under the supervision of the Board of Trustees. The contractor was JOHN CORKISH, of Seattle. Water is taken from the Palouse river, and can be pumped direct or to a reservoir. The reservoir has a capacity of 122,000 galls. There are 3,000 ft of kalamein iron mains, 20 taps and 6 hydrants. The works cost $8,000. There is a debt of $7,400 at 7½ per cent. Population of town, 800.

F. M. MARTIN.

Cuero, Tex.—The information given in last week's issue, under Crewe, should have been under Cuero.——S. K. FULTON, of Omaha, has sent us the following information regarding water-works he is now constructing at Culberston, Neb.

Culberston, Neb.—The works were designed and constructed by S. K. FELTON. Work was begun Nov. 1, 1888, and will be finished about Feb. 1, 1889. The water is taken from tube wells, supplied with Cook's cylinder and strainer, and elevated to a 20 by 30 ft. tank, which was furnished by Fairbanks & Co. There are 3,000 ft. of 4 and 6-in. cast-iron pipe, 25 taps and 7 hydrants. Eclipse hydrants and Ludlow valves were used. The works will cost $5,200. Population 1,500.

WALLULA, W. T., Jan. 16, 1889.

EDITOR ENGINEERING NEWS:—The Wallula Water & Motive Power Co. will let contracts in July for the construction of a system of water-works to cost $10,000. Work to be completed in September. The supply will be taken from the Walla Walla river, and be used for both fire and domestic purposes. Address G. CUMMINGS. Population 1,000. G. D. GOODWIN.

Whitesville, N. Y.

BUFFALO, N. Y., Jan. 18, 1889.

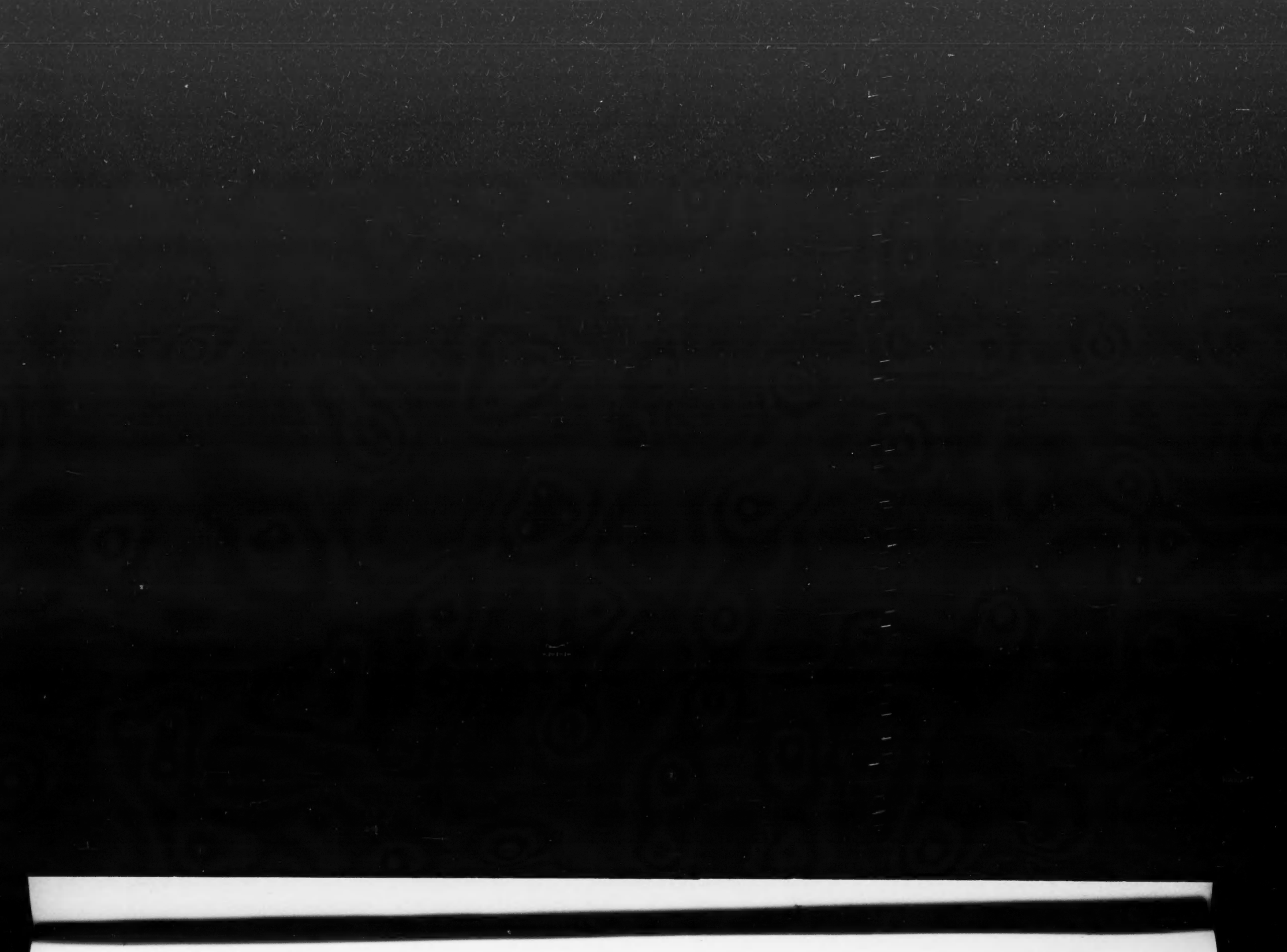
EDITOR ENGINEERING NEWS:—Water-works were built in Nov., 1888, by Hardwicke & Ware, of Buffalo, for the Whitesville Water Co. Water is conveyed from a spring to a reservoir. The distribution is by 4 miles of cast-iron pipe. The services are of galvanized-iron. There are 30 taps. HARDWICKE & WARE.

Austin, Pa.—Water-works are under construction by Hardwicke & Ware, and will be finished in the spring. About 3 miles of cast-iron mains will be laid.

Haverstraw and Grassy Point, N. Y.—

NEW YORK City, Jan. 21, 1889.

EDITOR ENGINEERING NEWS:—The West Haverstraw Water Co. was organized in 1888, with JOHN LOCKWOOD as President, to supply West Haverstraw, Grassy Point and Haverstraw. The company agreed to build a dam on the Miniseeongo creek, supplying the Garner Print Works, at Garnerville, Rockland County, and sto ing water to be used during the dry periods of summer, as compensation for taking the water from a stream which is supplied from what is known as Dorman's spring. The dam has already been built, and is 250 ft. in length, 20 ft. high, and will impound 600,000,000 galls. Another dam was built on the Dorman stream, 175 ft. in length and 15 ft. high, furnishing a storage capacity of about 2,000,000 galls. This reservoir is three miles from the village of Haverstraw, and at an elevation 265 ft.

The Haverstraw Water Co. has taken a lease of the West Haverstraw works for 99 years, and the whole territory is now supplied by gravity; the pumping machinery of the Haverstraw works having been abandoned. The cost of the new works was about $60,000.

JOHN LOCKWOOD, *President*